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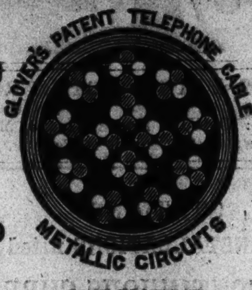

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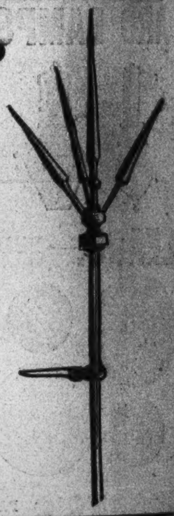

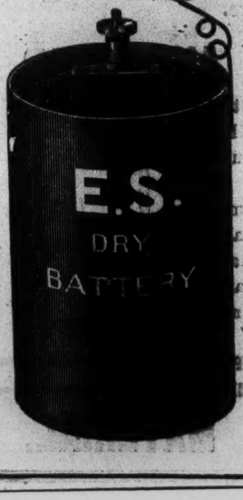

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TRAIN LIGHTING REVOLUTIONIZED.

MR. LANGDON must look to his laurels, not that he has any reason to dread the deep scientific training of the gentlemen who says that 50 volts × 20 ampères gives quite a different quantity of electrical energy to that obtained by multiplying 20 volts by 50 ampères, but because Mr. Arthur Shippey has evolved from his inner consciousness a plan which for originality and grandeur of conception leaves the genial engineer to the Midland Railway years behind the times. Mr. Shippey, like the other gentleman of deep scientific training, has a pet light—"a 20-volt low-resistance 10-candle-power lamp, made with a ring or duplex filament, so as to concentrate the light, which can be easily accomplished by enclosing such filaments in crystal and opaline, the upper half being opal and lower section crystal, so as to evenly distribute the light without waste of energy." But the lamps are insignificant compared with the grand scheme for generating the necessary electrical energy to supply them. Mr. Shippey pins his faith on an "ideal future method and most economical system" for generating currents for train lighting, which is nothing less than converting the locomotives themselves into thermo-electric generators, "which can easily be done by covering the outside of the boilers with properly-constructed thermo elements, so as to utilise the waste heat of the boilers, which would be ample to generate sufficient thermo current to charge small sets of storage batteries." That any railway directors or engineers could seriously pay attention to such a proposal as to cover their locomotives with these barnacle-like elements seems impossible, and yet Mr. Shippey assures us that his scheme was entertained some three years ago by the directors of the Great Western, but that, as the experiments were to be made at his own expense, he had to abandon the idea for a time.

He seems likely, however, to have more scope on the continent, a railway company there having an engineer by whom Mr. Shippey's *magnum opus* has been thought well of.

Although, so far, we have only spoken of the "thermopolaic locomotive" as a design and not as one of the real wonders of the world we live in, yet we must not omit to credit Mr. Shippey with those subtle powers of experimental research which characterise all seekers after truth endowed with inborn genius who tread the paths of science for the sake of adding their little contributions of discovery to the vast field of amassed knowledge. Although, curiously enough, Mr. Shippey, with apparent contradiction, modestly declares that he does not know whether his fundamental scheme is feasible or not until proofs are forthcoming from the Continent, yet from the splendid results obtained from an old kitchen boiler, he feels convinced that with a constant and regular supply of heat obtainable from railway engines and boilers, that the "thermopolaic" methods, as originally suggested by himself, can be made available for train lighting, steamship illumination, driving blowers for cooling engine rooms, and other purposes.

Shade of Stephenson! Fancy a locomotive, which, if not a thing of beauty, is a work of the highest art, plastered over with thermo-electric elements? Imagine, again, the condition of these delicate thermo-electric generators, mounted on an engine, racing at 50 miles an hour through rain, snow, heat, cold, and all the delightful variations of an English climate? No; Mr. Shippey is before his time: but he has the consolation of knowing that if he cannot succeed in utilising the waste heat of a locomotive in the manner indicated, he need never fear that a rival will rob him of the credit which is so justly his due. The magnificent monument to his brilliant conceptions stands alone, and nobody will desire to deprive him of even the most humble share in a scheme which, for originality and daring, will, in days to come, be spoken of as one of the greatest discoveries of the nineteenth century.

Watt immortalised himself by watching the generation of steam in a kettle, but it has been reserved for Mr. Shippey to make the kitchen boiler the means of revolutionising our systems of lighting the railway trains which Watt and Stephenson made possible, and of placing himself on the same high pedestal of fame as that upon which we have been accustomed to place these two celebrated engineers.

There is but one thing wanting to set Mr. Shippey's doubts as to the practicability of his plan at rest; let him read the article on Dr. Giraud's thermo-electric stove in our issue of May 15th, 1891, that on the Gülcher battery in to-day's issue, and then study the elementary principles underlying the construction and operation of these generators of electricity and their efficiency, and he will have no need to wait for advices from the Continent.

RECENT EXPERIMENTS IN ELECTRO-CULTURE.

In our issue for June 5th, p. 707, we gave an account of some recent experiments in the application of electricity to horticultural operations, and discussed the researches of MM. G. de Dubor, Barat, Spechnew and others in this direction. Our French contemporary scientists are always well to the front in exploiting new ideas, and the alleged affirmative results which have lately been obtained, in the application of electric light and electric currents to the growth of certain plants, have set a good many others at work upon this curious development of electrical science.

At present there is naturally a conflict of opinion concerning the use of electricity in agricultural and horticultural operations, and, as usual, there are some who entirely scout the idea that any good can result, or, at least, that there is "any money in it." On the other hand there are others who as strenuously affirm that we are on the eve of important discoveries, which shall lead to unexpected developments in the practical applications of electricity.

According to one of our French contemporaries, fresh evidence in favour of the advantage of employing electricity in plant culture has been adduced by Mons. Barat, of Aiguillon, Lot-et-Garronne, who is an enthusiastic believer in employing this agent, and has been at work with it since 1880.

In spite of the suspicion with which one is generally inclined to view the experimental results obtained by enthusiasts, it must be admitted that Mons. Barat's investigation bears every appearance of being genuine, and the account which he gives of it by no means highly coloured.

He applied electricity to the cultivation of potatoes, tomatoes and hemp—typical plants which indicate an unbiassed judgment in their selection.

A row of hemp was subjected intermittently, during its growth, to the action of an electric current; and with marked results. The stalks when mature measured 18 inches longer han those in another row which were grown under otherwise similar conditions, and during the same space of time.

Patches of potatoes were similarly treated, some being grown in the path of an electric current, whilst others were cultivated normally. Equally remarkable results were obtained in this case also; for, whilst 1 kilogramme of seed potatoes produced 21 kilogrammes of large and well-conditioned tubers, the same quantity of seed grown in a similar but not "electrified" patch only yielded a crop of 12·400 kilogrammes, and the tubers were by no means so large nor as healthy as in the former instance.

The influence of the electricity seems to be in producing early maturity; at least this was notably the case when the tomatoes were experimented with. Mons. Barat demonstrated that, under the influence of current electricity, the fruit ripened eight days earlier. Now, Siemens has shown that, under the influence of the electric light, fruits like strawberries, &c., ripened much faster. Hence, if Mons. Barat had also kept the electric light shining on his tomato plot at the same time as he was passing a current through the soil, it is possible that still more remarkable results might have been obtained.

Mons. Barat observed a fact, which is worth recording, during the course of his latest experiments, which, we may add, have been carried on during the past season.

When manure was placed in the neighbourhood of the positive electrode, a kind of electrolysis was set up in it whilst the current was passing, which had the result of transporting the elementary constituents of the manure in the direction of the negative electrode. Thus the fertilising effects of a small quantity of manurial substance was disseminated to a considerable distance in much less time than could be performed by ordinary liquid diffusion.

This is new evidence in favour of the theory adopted by Spechnew, the Russian agriculturist, whose researches into the causes why an electric current appears to produce greater fertility in the soil through which it is passed led him to ascribe it to a kind of electrolytic action, whereby the active principles existing in the soil, or in the manure which it is treated with, are scattered in such a way that they are brought into a more available position as regards the roots of the plants, and thus the latter get a better food supply.

Really, if all these experiments be true, and if the application of electricity to plant culture should prove to be *economically* possible (concerning which, by the way, these enthusiasts are usually *somewhat* reserved), some of our young electricians, who cannot find room for their energies to expand, might do far worse than turn electro-horticulturists.

Our Contemporaries.

In the opinion of our American contemporary, *Electricity*, some statements which have been appearing in the columns of a London electrical journal are apparently very inconsistent. The article *Electricity* comments upon, has reference to English manufacturers' exhibits at the World's Fair, Chicago, in regard to which subject the London paper states that Englishmen have nothing to learn in America anent electrical engineering. We quite coincide with the ideas of *Electricity* in the statement that that would not be a good reason for not exhibiting there, for, of course, if there were nothing to learn, there would be something to teach, and the Americans are ever ready to learn everything concerning any new departure. Mr. Dredge, the editor of *Engineering*, when conversing on the same subject with a representative of *Electricity*, said that he thought there were several good reasons why a first class representative exhibit should be made by English electrical men. Referring to the statements in our Metropolitan paper, Mr. Dredge is alleged to have stated that English manufacturers and electrical men are not likely to be governed in their policy towards the World's Fair by the opinions expressed by that journal. Mr. Dredge's judgment also was that Englishmen had a great deal to learn from America, and, as a matter of fact, English electricians returning from America generally brought with them valuable and practical information. This is a matter to which both Mr. W. H. Preece and Prof. Geo. Forbes have referred to on several occasions, expressing similar views, and we ourselves cannot reasonably accept our London contemporary's statements. The McKinley tariff will doubtless be a great drawback to English manufacturers wishing to exhibit, but we believe this will only apply to a few small firms, and that the larger manufacturers will have something worth exhibiting, but it is of course useless to attempt to forecast anything on the matter at the present moment. It is to be hoped, however, that the Exhibition will be a successful one.

Lightning at Sea.

For some time past it has been remarked that ships at sea are far less often damaged by lightning now than was formerly the case when wooden ships were so much in vogue. This has been noticed even under the tropics where violent storms are very frequent. According to some returns made of the satistics that have been accumulated since 1879 by the German authorities, this must be attributed to the general use which is now made of wire rope for rigging purposes as well as to the fact that the hulls of ships are usually constructed of iron or steel. Thus the whole ship forms an excellent and continuous conductor by means of which the electricity is led away into the ocean before it has time to do any or serious damage. Captain Dinklap, who has had charge of the commission appointed to investigate this question, states that no case has been recorded where a ship rigged with wire rigging has sustained any damage from lightning, except in a few instances where continuous connection had not been made with the hull. But wooden ships rigged with ordinary rope rigging still show the same percentage of casualties as formerly, when they are not properly fitted with lightning rods and the proper precautions taken to maintain their efficiency.

A Rival?

Some enthusiasts have been *foreseeing* a possible rival to the electric light in the little experimental lamp exhibited by Mons. Paquelin, the other day at the Academy of Science, in Paris. This little apparatus, it can scarcely be called a lamp, presented the following essential features: A small ribbon of platinum foil was rolled upon itself in the form of a cylinder and enclosed in a receptacle of the same metal. A gaseous mixture consisting of air and the vapours of certain hydrocarbons was now slowly urged though the apparatus under a slight pressure; then the mixed gases were inflamed, with the result that the platinum ribbon became incandescent. The mixed gases were then forced through upon the ribbon under an increased pressure; the incandescence was thus kept up, and "rivalled in brilliancy that of the electric light." Are we at the dawn of a new era? Is the knell of electric illumination already being sounded? or, to be more correct, is the extinguisher going to be put on?

The Growth of Electric Lighting.

Referring to the note under this heading in our issue of August 28th, our American contemporary, the *Western Electrician*, proceeding to criticise Mr. W. H. Massey's letter to the *Times* regarding the relative positions of electric lighting in England and America, states that he makes a very loose and indefinite statement, and as it stands carries no weight. Our contemporary thinks that if Mr. Massey had given the names of his American cities, with the number of lamps in each, and then set opposite the total number with which London is credited, his figures would have been interesting and entitled to critical examination. Without, however, having the statistics of the English Metropolis at hand, the *Western Electrician* has not the slightest doubt that Mr. Massey's statement is entirely incorrect. It is confident that in respect to the actual number of incandescent lamps, London will not prove greatly superior to an equal area in population in America.

A Talk with Professor Crookes.

The *Weekly Oracle*, presuming on the success of the recent interview with Mr. Massey on the subject of electric lighting, presents to its readers in its latest issue a garbled conversation between Prof. Crookes and its representative. A visit to Mr. Crookes's house filled the interviewer with strange fancies and with stranger facts. "Born" says he, in 1863 (*sic*), he is therefore well advanced towards the scriptural age of three score and ten. No doubt the newspaper man thoroughly enjoyed himself, and saw many wonderful things, including a little tiny, toddling lamp, no bigger than a pea. Then he mysteriously warms to the subject and when the professor switches on the light says, somewhat incoherently, "instantly the room was flooded with a soft radiance which was delightful both to look at and for useful purposes." Speedily the conversation became a little easy and the worthy professor is called prof. Then is the reporter instructed how to tell a bad quality of electricity from good. If he grasps a live wire and it kills him, he must consider that it is bad; but "if it soft as silk remains" then it is good, and is to be obtained from the Notting Hill Electric Light Company, Limited. "How does the electric light *stand* abroad?" asks the reporter; a matter, perhaps, at the moment fraught with a personal interest. After assisting the man—we mean the light to its legs—Prof. Crookes proceeds to denounce the work done in America, and the interview is shortly afterwards concluded.

The Theory of Dissociation into ions and its consequences.

The dissociationists in opposition to Arrhenius's original view now hold that the dissociation of compounds evolves heat, the evolution being due to the combination of electric charges with the atoms. Mr. S. U. Pickering who has recently made some important contributions to the controversy which is at present going on respecting the dissociation hypothesis now raises the question as to the origin of such electric charges in the absence of the expenditure of external energy and the absence of friction, induction and contact difference of potential; also how an affection of matter (a charge) can combine with matter to produce heat and itself remain in *statu quo*; and how the opposite electrification of the different atoms can, contrary to the older electro-chemical theory, dissolve the union between them. Mr. Pickering characterises both this view and that of the ions being allotropic atoms with less internal energy than ordinary atoms, as an hypothecation of a new form of matter to satisfy a theory which is inconsistent with known matter, or a verbal alteration designed to conjure away a stock of energy, so that the theory may not be said to be contradicted by the principle of the conservation of energy. Dilution is held to increase dissociation, and, since in the case of calcium nitrate heat is thus absorbed, gaseous calcium nitrate should, on dissolving, absorb heat, for it thereby becomes dissociated; but this cannot be true, for it can be shown that gaseous calcium nitrate would evolve heat on dissolution. Mr. Pickering contrasts the present dissociation hypothesis with that proposed by Clausius, which requires only the presence of a few atoms freed by accidental superheating, or else the continual interchange of atoms between contiguous molecules. The presence of any free atoms, however, he considers as opposed to the fact that molecules of the elements are not formed in solutions, and suggests that polarisation currents may be explained by a coating of oriented molecules, not atoms.

MAGNETIC CIRCUITS AND THEIR MEASUREMENTS.[*]

By H. E. J. G. DU BOIS.

TEN years ago, when the first amazement produced by the wonders of electricity had subsided, engineers set themselves to detail work and attempted to design reasonable dynamos and motors; the history of steam engines began to repeat itself. For this they wanted a theory; but in the literature of electro-magnetism, though voluminous enough, nothing was found that could be utilised. Since then, the two principal worthies of science, British and Continental, have stated that, in their concordant opinion, all that was wanted might at the time have been found ready by diligent searchers. Allusion was made to writings (in the reverse of chronological order) of Maxwell, Sir Wm. Thomson, Faraday, as far back even as Euler.

However this may be, engineers finding no assistance from science, helped themselves. History will give them due credit for this; science can do no better than annex the ground covered on that side in a state, however, modified to suit her wants and cleared from much that is superfluous or even wrong.

During the last decennium, investigations appeared by Bosanquet (1883), Rowland (1884), Werner v. Siemens (1884) Gisbert Kapp (1885), Pisati (1890), in which closed electro-magnetic systems are considered analogous to electric circuits, and have Ohm's law applied to them. However, I hold the latter to essentially involve that the ratio of E.M.F. to current is constant, irrespectively of the amount of current. Now the magnetic flux of induction (alias number of lines of force) is, neglecting hysteresis, a single-valued function of the so-called magnetomotive force; but these quantities not being in the least proportional, it seems to me unwarrantable to introduce their ratio as a resistance in the sense of Ohm's law. This would lead one to divide the argument of any function by the latter and introduce the quotient as a mathematical resistance against the increase of the function. In physics we would then have none but ohmic laws.

The conception of the magnetic circuit is doubtless a fruitful one, and the introduction, for practical purposes, of an (essentially variable) resistance may be recommended. But I think the use of Ohm's name is sufficiently wide-spread already, and should not be tolerated in connection with our present subject. Still less should magnetic shunts be treated under the auspices of Kirchoff and his rules, such treatment giving nothing but false results.

These criticisms do not apply to Hopkinsons' classical paper which marks the modern epoch of the subject. In fact they never mention an ohmic law; they simply start from two absolutely safe propositions, viz.: (1) The many-valued lamellarity of H; (2) the solenoidality of B; the latter is, of course, *the* theorem in the "tubes-of-force" theory. Their paper is often considered a practical one on account of the dynamo experiments in it. But science claims it as hers for the essentially scientific method followed.

I would now principally show how we may manage without tubes-of-force, the importance and elegance of which is not in the slightest degree denied. We may go as far by considering, in the old-fashioned way, magnetisation at individual points in the iron. We need not even be physically ultra-conservative to prefer this method to looking at the magnetic circuit as a whole, because recent experiments teach us to consider magnetisation as the quantity physically more fundamental than induction. However, within the range occurring in practice, these quantities do not differ by more than the factor 4π.

I was glad to find that Prof. Ewing to a certain extent follows my method in his latest paragraphs on the magnetic circuit, published in the *Electrician*; on the other hand, I regret that after so excellent an exposition my present remarks may appear rather superfluous.[†]

I.

In terms of the old theory of magnetic induction, as classically expounded in Maxwell's treatise, the behaviour of an ellipsoid of revolution is determined in the now well-known manner by the factor N; we might appropriately call this the "self-demagnetising factor," though a shorter name would sound better. Such an ellipsoid with the closed tubes-of-force surrounding and pervading it, may, of course, be conceived as a magnetic circuit; however, in the present case this would certainly not lead to so simple a mode of representation.

As regards magnetic circuits in the more usual sense, their simple type is a thin ring, uniformly and peripherically magnetised and provided with a radial air-gap. This case is reducible to the preceding one as soon as the factor, N, is known. It is found that

$$N = \cdot 035\, a \text{ or } = \tfrac{1}{8}\, p$$

where a is the width of the slit in degrees, p the same in per cents. of the mean periphery. This result is most simply obtained by considering the line-integral of the self-demagnetising force which must vanish when taken around the ring; it is deduced for an infinitely narrow gap. The result may be put somewhat plausibly by considering the gap as a magnetic shell; for this we may substitute the equivalent current almost uniformly counteracting the rest of the uniform winding. The action of such local coils on rings has been experimentally investigated by Oberbeck in 1878.

The amount of deviation of the above equation from the truth with increasing width of the gap must be determined by experiments; these are now being made by Mr. H. Lehmann in the Berlin University laboratory. This ring (shown to the audience) is turned out of Swedish plate; it is uniformly wound with three primary and one secondary layers. The gap now covers $\frac{1}{5}$th per cent. of the circumference; preliminary experiments gave good agreement with theory for intense magnetisation. When the latter is less (as would occur in practice) a sufficiently constant value of N was found; this is smaller than that given by theory in a ratio which must be related to the leakage coefficient of the tubes-of-force theory. Details will be published after the completion of the experiments.

The two typical cases, ellipsoid and ring, have now become entirely comparable. The curve of magnetisation, $I = \text{funct.}\,(H)$ for endless pieces (infinitely long ellipsoids or closed rings) I shall call the normal curve. From it we find the curves for shorter ellipsoids or for rings gradually opening out by Ewing's "shearing" of the diagram. We soon see the curves merging into a characteristic form adapting itself to two straight lines. The first of these passes through the origin and forms an angle, $\tan^{-1} N$, with the axis of ordinates. The second runs parallel to the axis of abscissæ at a distance corresponding to the maximum values of the magnetisation. The first straight line depends upon the shape of the magnetised body only, the second upon the material, whereas the point of intersection is determined by both. The same holds for the parts of the curve near each of the straight lines. Now we may, at least as an approximation, consider these as the asymptotes to an hyperbola, the equation of which is found to be

$$x = N\,y + \frac{P}{1 - y}, \text{ or } x = \frac{N\,y + (P - N\,y^2)}{1 - y},$$

here P is a second constant; the unit of ordinates is the maximum magnetisation.

It is interesting to compare this with the old well-known hyperbolic curve of O. Frölich, the equation of which (in the above convenient unit) may be written:

$$y = \frac{1/Q\,x}{1 + 1/Q\,x}, \text{ or } x = \frac{Q\,y}{1 - y}$$

here Q is that value of k for which y becomes $= \frac{1}{2}$; *i.e.*, the iron is "semi-saturated" or, as Prof. Silvanus Thompson has it, reaches its "diacritical point." The equations are seen to differ by the term $P - N\,y^2$ in the numerator. Frölich's curve has a different flatter shape than the one deduced above and it is always impossible to give Q a value so as to fulfil the conditions prescribed. From the purely electro-magnetic point of view, I therefore prefer my own hyperbola, leaving it to competent judges to decide on the practical applicability of Frölich's curve of "effective magnetism."

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[*] Translated and abridged from a paper read in Section I. of the Frankfort Electrical Congress, September 11th, 1891.

[†] The original German paper was prepared before these articles appeared; so far as the ground is already covered by Ewing, the present English translation is cut down.—d. B.

In conclusion, I remark that the "shearing of the diagram" is not restricted to ellipsoids and rings, but may be applied (approximately) to bodies of any shape. The mean factor, N, for a given shape may be found by experiment. Lord Rayleigh's original construction is thus generalised to the utmost.

II.

A few applications remain to be mentioned.

In the first place a question exists, the solution of which may now be attempted. It is the construction of electro-magnets for producing fields as strong, as uniform, and as extensive as possible. The problem is well defined; its conditions essentially differ from those which have to be fulfilled, say, in a dynamo; still a rational solution must be feasible with our theory. In any case something better may be expected than the purely empirical types now used. It is hardly necessary to dwell upon the importance of such improved apparatus for further experimental advance in magnetism.

In the air-gap of the ring above mentioned, we may obtain a field of almost 20,000 C.G.S., with a current of 20 ampères. By general theorems of Sir. Wm. Thomson's on similar electro-magnetic systems, we get the same on magnifying the whole arrangement, say, to five-fold linear dimensions and using the five-fold current of 100 ampères. By conical pole pieces, bored if necessary, we may considerably concentrate the field, though its extension and uniformity are thereby reduced. We know more about such cones now from late investigations by Stefan, Ewing, Czermak, and Hansmaninger. We have still to cut through along C, in order to be able to vary the distance of the poles within certain limits. Such an electro-magnet is being built at present from my designs by Messrs. Siemens and Halske.

In conclusion, I have to demonstrate an instrument intended to meet the want of a rapid and simple method for determining magnetic curves of materials used in machine construction. The existence of a demand seems to be proved by the number of attempts made to supply it. We have Hopkinson's bar-and-yoke, Swinburne and Bourne's differential inductive method, Silvanus Thompson's permeameter, Rœpsel's open circuit torsion apparatus, Eickemeyer's differential magnetometer, Corsepin's siderognost, Bruger's bismuth spiral apparatus. It appears that in America Edison and others proposed various other arrangements, about which we never heard much. It would lead too far to enter into a description, or even a critical discussion, of all these more or less known instruments. I restrict myself to shortly describing a new solution of the problem and showing the apparatus.

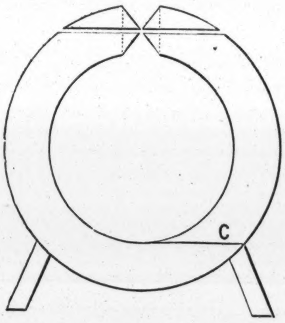

FIG. 1.

The leading constructive principle was to insert the cylindrical test sample as the principal resistance into a magnetic circuit. As it is quite impossible to reduce the rest of the resistance so as to make it negligible, it must be capable of being simply corrected for. It therefore consists for the greater part of air, for the smaller of Swedish iron of large cross section. The induction, B, in the circuit has to be measured, and it is very tempting to do this by means of the considerable tension of the lines-of-force in the air-gaps, which amounts (in kilogrammes) to very nearly $(B/5,000)^2$.

The tension might be measured in different ways, *e.g.*, 1. By sucking in an iron ribbon. 2. By manometrical determination of the hydrostatic pressure in a liquid filling the "interferric" spaces.* 3. By compensating the tension by weights. I chose the latter method as the simplest, though not direct reading.

The practical application is realised in this magnetic balance (of which fig. 2 gives a rough idea). The test sample, T, which need not necessarily be circular, is cut to a length of 15 cm. and automatically clamped between the two massive vertical uprights, V_1 and V_2. It may be subjected to fields up to 500 C.G.S. by the coil, C, of length, 4 π cm., so that field $= \frac{1}{10} \times$ ampère turns. Above the uprights a yoke, Y, is eccentrically supported; magnetic attraction, equal on both sides by symmetry, therefore produces a resulting moment on account of the unequal leverage. This is compensated by a weight, W, sliding along a scale.

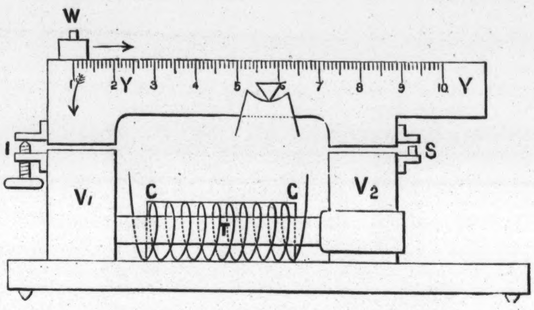

FIG. 2.

The yoke is balanced and adjusted so as to make its purely static equilibrium almost neutral. On magnetising it then becomes unstable; the position of the weight is read on the scale, which just pulls the yoke off the insulated contact screw, I. The instant of breaking contact is best determined through having a galvanoscope, bell or telephone in circuit; it is perfectly well defined. The iron surfaces are, of course, prevented from touching by the stops I and S, over which the yoke plays like a Morse key; its motions, of very small range, do not appreciably affect the magnetic resistance of the whole circuit.

The apparatus was calibrated by means of a sample of 1 cm^2. cross section cut out of the same Swedish plate as the ring above mentioned; its normal curve was therefore known. With a small secondary coil and ballistic galvanometer the flux of induction, G, in the central part of the test-piece, was measured for different values of the magnetising field. If the percentage leakage of the circuit be made sufficiently independent of the magnetisation, the scale-reading is proportional to the square of the flux as above determimed. By adjusting the weight and screws the factor of proportionality may be made a round number. The magnetic curve as found with the sample in the balance was drawn beside the normal curve and from the differences of the abscissæ the factor, N, was at once known. This remains a constant characteristic of the balance, provided the cross-section of the samples afterwards tested does not differ too much from 1 cm^2.

Magnetic curves may afterwards be obtained simply by measuring the current in the coil and balancing the beam. They are best drawn directly from an axis of ordinates inclined towards the left through an angle equal to $\tan^{-1} N$. The balance exhibited was made from my working drawings by Mr. W. Oehmke, of the Berlin Physiological Institute; it has the following constants:—

H Field (C.G.S.) ... ... $= 50$ Current in coil. (ampères)

G Flux of induction (C.G.S.) $= 1,000\,\pi\,\sqrt{\text{scale-reading}}$.

or B Induction (C.G.S.) ... $= \dfrac{1,000\,\pi\,\sqrt{\text{scale-reading.}}}{\text{cross-section.}}$

or I Magnetisation (C.G.S.) ... $= \dfrac{250\,\sqrt{\text{scale-reading.}}}{\text{cross-section.}}$

N $N = 1/60$

Range $1,700 > I > 0$

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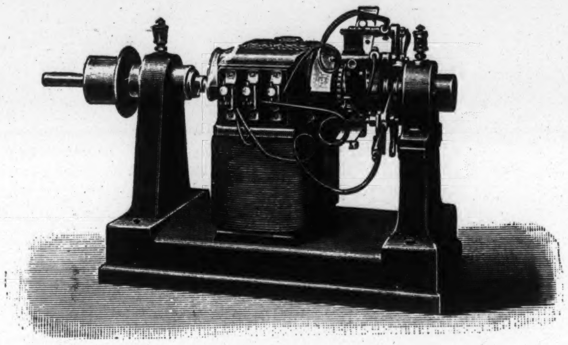
* French: entrefer (Hospitalier).

THE UNIVERSAL PATENT PLATING DYNAMO.

We illustrate below a new dynamo which is being manufactured and introduced under sole licence from the patentee, by Messrs. T. L. Hemming & Co., of Birmingham, which for electroplating purposes, or any purpose requiring low pressures, is said to possess very substantial advantages over any machine before produced. Hitherto, dynamo builders have had to resort to reducing the number of convolutions on the armature, and consequently the sections of the commutator to the lowest practicable number; to reduce the strength of the exciting field, and finally to reduce the speed of the machine, until something approaching the correct voltage is reached.



Generally (unless the machine is a very small one) a considerable amount of resistance must be included in the circuit in order to bring the pressure on the vat terminals down to the required value. Now, reducing the number of sections on the armature and operating with a weak field are both prejudicial to the working of a machine as regards sparking, and the low speed means a small output. The result is that up to the present machines for electroplating have been far behind those for lighting purposes as regards sparking, and much larger than would have been required had their full capacity for generating electrical energy been available for useful work.

The novel features about the "Universal" dynamo consist in making a number of deep channels or slots in the polar sufaces parallel to the axis of the armature, and applying light subsidiary or intermediate brushes to corresponding points on the commutator of the machine, between any two of which half the total current which the armature is constructed to carry can be drawn off at a voltage determined by the winding of the armature, and the fraction of the total field which is cut by the coils between the two brushes. The effect of the channels in the polar surfaces is, of course, to produce corresponding weak places in the magnetic field, with the result that the coils may be short circuited when passing through these positions by the subsidiary brushes without any harmful effect; in fact, under certain conditions, *i.e.*, when the current generated in the short circuited coil by the weakened field is equal to the current flowing in the next section to which the coil is passing, the sparking will be *absolutely nil*. The invention can be applied to either ring or drum armature machines, but, except in special cases, the drum armature is the most suitable.

With a drum armature machine, no matter whether current is drawn from one side only of the commutator or from both sides at irregular positions, the distortion of the field is the same on both sides of the armature as the wires of any coil are on both sides; but with a ring armature the effect of current in one part of the armature different in value to the remainder will, of course, cause local distortion and possible sparking.

With a drum armature the channels on either pole piece must be diametrically opposite, but with a ring armature the two polar surfaces may be divided into different numbers of portions so as to get different voltages on one side to those obtained on the other.

The additional brushes are not found objectionable in practice; they never have to carry more than half the current which the main brushes carry and generally carry much less than half, so they can be made very light. With a drum armature, or with a ring armature when the channels and brushes are alike on both sides, the subsidiary brushes may be connected together in pairs (the brushes which are the same distance from one or other main brush, of course, being connected together) *not* those diametrically opposite, except in the case of the central ones.

Under this patent Messrs. T. L. Hemming & Co. construct machines to give 10 volts at main brushes for plating, say, with brass, 7·5 volts for nickel plating, and 5 and 2·5 volts for silver and copper depositing. Obviously, 4 vats, of 2·5 volts each, can be employed if desired, the E.M.F. in either being practically unaffected by the current in the others, although the vats are connected in series. If the user desires, he can connect up his vats upon the 3 wire (or rather multiple wire) system; but this is not essential as the distances are not usually great, so that separate leads can be brought to each brush from the vats.

Thus in the "Universal" dynamo, while a good output can be obtained from the machine, a sufficient number of sections can be employed to secure absence of sparking.

THE ELECTRIC LIGHT AT BUDAPEST.

[FROM OUR OWN CORRESPONDENT.]

On the morning of September 23rd the tenders for introducing the electric light into Budapest were handed in and were examined by a mixed commission.

The tenders were four in number, one from the Board of the Budapest Gasworks, represented by their technical director, L. von Stefani; one from the Budapest Tramline Company (Siemens & Halske) represented by Moraz Balázs; one from the Budapest Machine Works (Ganz & Co.), represented by Béla Fischer, and the fourth from the local firm, B. Egger and Co., in league with Schuckert & Co., of Nurnberg, represented by D. Egger.

The Gasworks ask for a concession for 45 years, after which the net of leads becomes the property of the city. If the city wishes to buy the works at an earlier date they offer at any time after December 15th, 1910, to sell the net and the stations as a going concern at a judicial valuation. As the maximum price per carcel-hour they ask $1\frac{1}{2}$ kreuzers, and per volt arc lamp (600 candle-power) 15 kreuzers hourly.

As the maximum price of energy per horse-power, hourly, they fix $29\frac{44}{100}$ kreuzers.

For the energy consumed in street-lighting they offer a discount of 40 per cent., and in their charge they include attending and cleaning the lamps and renewing the carbons. On the electricity consumed by the Municipality, other than in street lighting, they offer a discount of 5 per cent. They demand no fundamental tax either per lamp or per 100 watts. The electricity-meters will be supplied on loan *without charge*. They purpose to lay down leads at first in the streets over a length of 10 kilometres, and to extend the net as required. They purpose using alternating current and continuous current, in combination with accumulators, in such a manner as to secure the advantages of both systems. The central station will be erected on their plot of land at the Hausenfang. The work of construction will be commenced as soon as the agreement is signed, and the company hope to begin the supply of electric current at the end of the year.

The Siemens and Halske undertaking request a concession up to January 1st, 1940. They are prepared to sell at any time on receiving 5 years' notice. Their maximum price for current is to be per carcel-burning hour in glow-lights $1\frac{59}{100}$ kreuzer, and $\frac{15}{100}$ kreuzer for arc lamps. For power they ask 10 kreuzers per H.P. hour. On the current used for street lighting they allow 25 per cent. discount and agree to light the Waizner Street gratis during the entire duration of their concession. For meters they charge up to 10 glow lamps at most 10 florins; up to 25, at most 16 florins; and up to 100 glow lamps at most 25 florins.

The first cable net will be laid down along a number of streets marked in the plan, and will be extended at request. The central station will be in Kertéss Street at first and afterwards in the Soroksaerer Road.

They propose using at first continuous current, and at the wish of the authorities high-tension alternating current. Operations will begin within four weeks of receiving the concession, and current will at once be supplied for light and power by means of accumulators.

The combined firms, B. Egger & Co. and Schuckert & Co., ask for a concession for 35 years, after which the entire net passes gratis into the possession of the Municipality, whilst the machinery will be taken over at a valuation.

At the end of 15 years they are prepared to sell the fixed plant at its estimated value, the pipes, machines, &c., at 50 per cent. *above* such value.

Consumers will have to pay 5 kreuzers per 100 watts if for lighting purposes hourly and ·3 kr. for a 16 candle-power glow lamp per hour burning.

For the supply of power they propose a complicated system of charges; on the energy supplied for street lights they will allow a discount of 10 per cent.

If the Municipality grants them the concession for the entire city and territory, they will pay over 10 per cent. of the gross receipts, if there are two concessionaries, 7½ per cent., and if there are three, 5 per cent. They desire no fundamental tax. For the hire of the meters they propose a somewhat complicated scale of charges.

If they receive a concession for the entire territory, they will supply alternating current from the central, whilst the subordinate stations will be arranged partly for continuous and partly for alternating current. If they only receive a partial concession they will use continuous currents on the three-lead system with accumulators. They will begin operations in not less than six months.

Ganz & Co. apply for a 50 years' concession, at the expiry of which the leads, plant, &c., pass gratis into the hands of the city. The city will be entitled to purchase the whole undertaking after 20, 30 or 40 years at a price to be agreed on. The maximum price for lighting is 5 kreuzers hourly per 100 watts. For large consumers a scale of discounts is proposed. On the current consumed for public lighting they allow 30 per cent. discount and claim no fundamental tax.

For motor purposes the charge will not exceed 4 kreuzers per 100 watts.

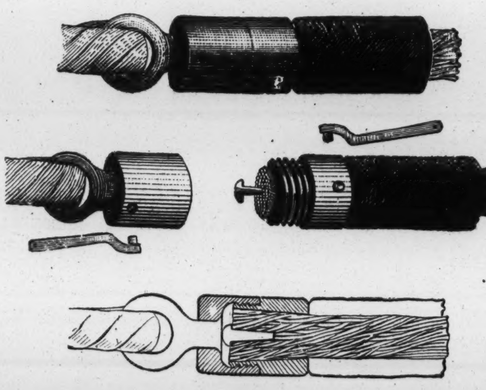
A fundamental tax of 6 florins yearly per 100 watts will be required from private consumers.

The yearly hire of meters will be up to 500 watts, 10 florins, up to 1,200 watts, 16 florins, up to 2,500 watts, 20 florins, and up to 5,000 watts, 25 florins.

They propose using alternating currents with transformers. They are prepared to begin operations before the end of the year.

IMPROVEMENTS IN DRAWING IN CABLES.

When drawing electric cables into pipes, Callender-Webber cases, or other conduits, it is necessary to make a secure connection between the cable and the rope by which it is to be pulled in. It is also necessary that such connection should be small enough to pass through the pipe or case. The method usually adopted at present is to make a splice by cutting out the centre strands of the conductor and "marrying" the outer strands to those of the rope.



Mr. A. A. Voysey has devised a grip designed to avoid the waste of time and material entailed by the present method. It consists of a small ferrule, 2 or 3 inches long, tapered inside, and made so that the narrow end fits closely to the conductor of the cable. The ferrule is placed on the end of the conductor, narrow end foremost, the insulation being cut back 2 or 3 inches according to the length of the ferrule. When it is in position, a tapered pin is driven into the centre of the cable, and this spreads the strands so as to make the ferrule grip tightly. It is easy to see that any attempt to pull the ferrule off will now cause it to grip the strands more tightly. On to the end of the rope is permanently connected a small cap which can be screwed on to the end of the ferrule. Thus in two or three minutes a joint of smaller diameter than the cable can be made, capable of sustaining any strain required. After the cable is drawn in, the ferrule can be easily removed by taking out the pin, which is provided with a small head so that it can be knocked out. Mr. Voysey assures us that he has drawn nearly a mile of cable into Callender-Webber casing with his patent grip piece and it has acted perfectly, and never in any instance shown the slightest tendency to draw off the cable. It has also great advantages over the ordinary splice, which is apt to "ruck up" when being drawn past sharp bends.

To illustrate the advantage of the patent grip, it is only necessary to give the cost of carrying out the work without it by ordinary splice. Mr. Voysey takes a 91/11 cable, about which actual figures can be given. The cost is as follows :—

	s.	d.
Jointer, 1½ hour making and unmaking splice	1	0
10 men 1 hour awaiting splice	5	0
1 foot 6″ cable	11	6
Rope wasted and tape used to cover splice...	0	6
	18	0

With the patent grip the joint is made in two or three minutes, and there is no waste of cable or rope, since the strands which have been pushed out of place by the tapered pin can be easily replaced.

The grip is made from bar steel so as to get the greatest strength in the smallest space, and we think that it has only to be seen to be appreciated.

THE GÜLCHER THERMO-ELECTRIC BATTERY.

If inventors seem to have almost given up the idea of arriving at an industrial hydro-electric battery suited to applications in which large quantities of energy are required, the same cannot be said as regards the direct transformation of heat into electrical energy. The arrant imposture known as Edison's pyro-magnetic generator has not cooled the ardour of inventors, but they have given up the employment of thermo-magnetic phenomena, and have wisely come back to simple thermo-electric phenomena, seeking to improve the construction of the apparatus, the utilisation of the heat, and the composition of the alloys. We described, some months ago, M. Giraud's thermo-electric stove, which is now being constructed for industrial purposes, and will be in the market in a few weeks. We will now discuss M. Gülcher's thermo-electric battery, which has received from the English and continental press eulogiums which, in our opinion, are somewhat premature.

M. Gülcher exhibits at Frankfort some thermo-electric batteries heated by gas, and *designs* for a thermo-electric battery to be heated by coal. The gas thermo-electric battery differs from other similar batteries only in the arrangement of the elements, which are placed in a horizontal row above a gas burner of the same length. The elements are made of nickel and an alloy of antimony and other metals, the proportions of which are not known.

The element of the large model consumes 200 litres of gas per hour, and has an electromotive force of 4 volts. Over an external resistance equal to its own resistance, it produces a current of 5 ampères, which corresponds to a *total* power of 20 watts, and an *available* power of 10 watts. (In some journals these two values have been confused, and the Gülcher battery has been credited with double the powers that it really possesses.)

The consumption of gas is therefore equal to 20 litres per watt hour, or 20 cubic metres per available kilowatt hour.

To show what progress has been made in this direction, we may observe that the Clamond battery constructed by M. Carpentier, which is heated by gas, consumes from 30 to 40 cubic metres in producing the same quantity of available electrical energy. The improvement is therefore considerable, but a good gas motor, driving a dynamo, would only consume about 1,300 litres of gas in producing 1 kilowatt hour, so that the consumption is still 15 times as great with the thermo-electric battery. The thermo-electric battery heated with coal, the designs of which alone are exhibited by M. Gülcher, would have an electromotive force of 80 volts, and would give an output of 10 ampères under the conditions of maximum effective power.

These figures correspond to an effective available power of 400 watts. The consumption being 2 kilogrammes of fuel per hour, the effective kilowatt hour would be obtained with an expenditure of only 5 kilogrammes (11 lbs.) of fuel. For a generator of such low power, these figures are not excessive, but they require to be confirmed by the Experimenting Committee at the Frankfort Exhibition.

The enthusiastic reports to which we have alluded have no doubt been evoked by the confusion in the minds of the writers between the *total* power of the Gülcher batteries and the *effective* power. A thermo-electric battery always consuming the same quantity of fuel, whether the circuit is open or closed, should naturally always work under conditions of maximum effective power; the electrical rendering is therefore only 50 per cent., and the difference of potential at the terminals only half the electromotive force. We can therefore only utilise half the electromotive force, and the battery of 10 ampères and 80 volts of electromotive force only really produces 400 effective watts, not 800.

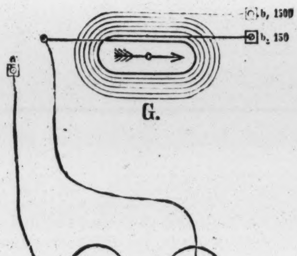
GALVANOMETERS.

THE galvanometers of the Allgemeine Elektricitäts Gesellschaft of Berlin, for whom Keys' Electric Company are the sole representatives for this country and the colonies, are claimed as showing their superiority over the majority of those in general use by their greater reliability and the readiness with which their records can be read off without entailing the necessity for any intricate calculations.

The diagram and figure illustrate the compact and convenient form of the instrument, which is equally suitable for the determination of insulation resistances, for testing joints, and for laboratory and workshop use, as well as for installation work, central station use, and line testing.

Resistances of 500 to 1,000,000 ohms can be measured with an exactness quite sufficient for almost any practical purpose.

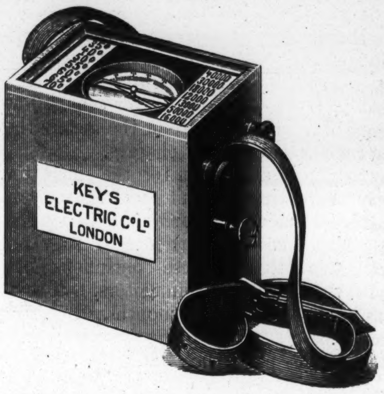
These instruments consist of an exceedingly sensitive galvanometer, connected with a dry battery of the most approved form, in the manner explained by the annexed diagram, where T B represents the battery, G the galvanometer, having an outer coil of 1,500 turns of fine wire and an inner coil of 150 turns of stouter wire; *a*, one terminal, b_1 or b_2 (as may be required) the other, to which the outside resistance to be measured must be attached.



This latter is thus connected with the battery and galvanometer in series, so that the deflection of the needle gives a direct determination of the outer resistance, which, owing to its having been standardised before leaving the works, can be read off without further calculation or trouble, upon the calibration tables to be seen close to the scale.

A spindle, with finely pointed ends set in agate, carries at one end and within the coils a strong magnet, and above them a light pointer which plays over a finely divided scale. The large number of turns of fine copper wire, wound in sections, leading to the binding screw, b_1 (or b_2), permits the selection of the number of turns to be employed so as to correspond with the amount of resistance.

The dry battery is of high E.M.F. and great constancy. The instrument case is well nickelled, and the whole secured in a neat polished wooden box furnished with straps, so as to be conveniently portable and very compact.



The apparatus may be employed for:—

1. Circuit testing for earth or bad joints.
2. Insulation tests between magnet coils and iron parts in dynamo, &c.
3. Insulation tests between field magnets and armature.
4. Insulation tests between armature and earth.
5. Insulation tests between commutator and spindle.

Two sizes are made, one for resistances up to 500,000, the other up to one million ohms.

PRACTICAL PHOTOMETRIC RESEARCH.

By RALPH CONRAD RICHARDS.

(*Continued from page* 391.)

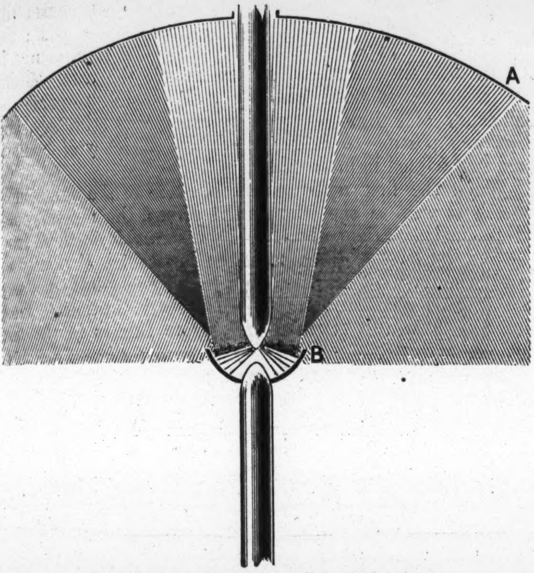
OPTOMETRY.

THE title of this article will doubtless fail to convey any special impression to those who have not gone beyond the average limits of photometric work, as culled from the one or two isolated text-books on the subject. It has suggested itself to the author that this would be the fitting title of that branch of the science which he is introducing here for the first time, viz., the measurement of the dilation of the pupil; be this approximately or otherwise, really it is not the actual size of the optic aperture of the diaphragm of the human eye, which it is desirable to measure, but the facility with which individuals are enabled to see the details of objects whilst the rays from a brilliant light are exerting an influence of a disturbing character.

In the first article the writer pointed out indirectly the enormous gain which the enlargement of the radiative surface of a luminous source would entail, were it possible to effect this without altering the efficiency otherwise; in other words, a brilliant light should be scattered as much as possible to attain this maximum efficiency, always remembering that the same area be illuminated before as well as after this dispersion or scattering. It has been frequently pointed out in these articles that the best method of accomplishing this lies in the employment of a reflector arrangement, embodying the principle which is utilised in fig. 9.

This, as was explained in the first article of this series (ELECTRICAL REVIEW for January 30th), consists of two parts, one designed to shut off all the rays from the eye;

this, at the same time, reflecting those of downward emission upwards to the second part, which consists of a large concave dispersing reflector, which may consist of either frosted and silvered glass, facetted silvered glass, or of a surface of grained or engine turned silver. This reflects, or rather disperses, the rays in all directions, and may, by employing a concavity of suitable proportions, be so adjusted as to cause the rays, on leaving its surface, to cover any desired area. It will be quite unnecessary to discuss the employment of any other method, for reasons already laid down and emphasised by the author in previous articles. Now, it has been shown that when a brilliant light is so scattered the efficiency becomes enhanced in a manner which at once shows the futility of lighting by means of brilliant illuminants, when such modifications as the writer has suggested are absent. It is to the non-observance of this fact that the numerous failures to attain that degree of success in lighthouse illumination which the enormous photometric intensity of the electric arc ought properly to ensure, are to be attributed. It reflects little credit upon those who deem themselves authorities on the matter, that they should so glibly pronounce the electric arc a failure when the evil is so readily remediable; but it takes time to break through the barrier of bigotry and self-constituted authority, and perhaps all that might be written or said, would, in the face of such be useless, were it ever so concise or pregnant with truth. In this, the latest development of the science of photometry, the author has set himself the task of proving by suitable means the enhancement of luminosity which brilliant light sources undergo when suitably modified, or, as some term it, softened. Perhaps it will at the outset be wel to define the somewhat elastic term *brilliancy;* generally speaking, the word has been used without any definite meaning—gaslight, sunlight, and the light produced by the agency of electricity, are all said to be *brilliant;* and were it not known to be contrary to common sense, it might be assumed that they all partake of the same disagreeable characteristic to such an extent, that further investigation, so far from being unattainable, is useless, and therefore unworthy of the expenditure of energy which it might possibly entail.



A, large concave mirror; B, small parabolic mirror.

FIG. 9.

A convenient way of obviating any difficulty which might be thought to connect itself with the subject would be to define the unit of brilliancy as the light of one candle emitted from a surface whose area is one square centimetre. Thus far the definition is a good one, very simple and capable of most easy reproduction; but when speaking of brilliancy, it must, of course, be borne in mind that the term is generally taken to be the effect on the eye of a light source, irrespective of its distance; but this looseness is easily disposed of if the term be taken to imply merely the luminous radiation emitted from a surface of known and stated dimensions. The light of a candle is just as brilliant at the distance of a mile as it is at a yard, if it be considered merely as a question of surface radiation; if, however, the effect upon the eye be implied by the term, then it will be seen that the definition does not hold water, popularly speaking, although in scientific language a light appears just as brilliant at a distance of 100 yards as it would were it but a single yard distant. Now it is really unscientific to attempt to explain brilliancy, as though it were identical with luminosity, and to show that this is really a case of very frequent occurrence, it is only necessary to compare the two expressions—*a brilliantly-lighted room and a brilliant star,* two very characteristic utterances of the average conversationalist. It will therefore be desirable to point out that a room is not necessarily brilliantly illuminated by a brilliant light; for it is plain, from the fact that (neglecting the absorption of the air) the brilliance of a light source remains constant in so far as the eye is concerned, irrespective of the distance from the observer, that although a light may be very brilliant, it is not, therefore, adequate for the purpose it is required to serve. Now there is, as has been previously pointed out separately by the writer and Mr. S. A. Varley, a peculiar resemblance to the electrical law $W = E C$, this is apparent if W be taken to represent the effective illumination, E the brilliance (surface emission per square centimetre), and C the extent of the light source (expressed in square centimetres); thus it may be seen that the efficiency of any illumination depends upon two factors and not one. To render these considerations, if possible, more apparent, and at the same time to clear up any dubious definitions which still exist, the author has appended a few definitions so frequently used unmeaningly and unintelligibly. These are:—

1. Brilliancy or intensity: the luminous radiation per square centimetre of the surface of a luminous body.
2. Luminosity: the total luminous radiation of a light source.
3. Softness: a property of luminous bodies when the brilliancy is sufficiently small to cause but slight contraction of the pupil, and consequently to enable bodies to be seen more perfectly when the eye encounters the direct rays of the illuminant at the same time.
4. Diffusive power: a term practically implying the same as the preceding definition, but which is thoroughly unscientific, owing to the fact that light rays of any intensity travel at an equal velocity for the same colour.
5. Luminous power: a term implying the same as luminosity.

It is hoped that the above definitions may help to extricate photometric terminology from that peculiar illusive state into which it has been brought by the indefinite utterances of many who have found a difficulty in expressing themselves in an orthodox manner.

Now, a very important procedure on the part of all who desire to utilise luminous sources in the best possible manner is to secure the greatest amount of dispersive power possible of a light source by the use of suitable devices. Unfortunately this is a difficult matter, on account of an idea which seems to exist in many persons that a room is poorly illuminated if the brilliance of the light source is not great; this is to a certain extent true if the comparison be made without strict regard to correctness, a light source must appear more or less brilliant if the final illumination is to be perfect. If impossibilities of construction were possibilities easily satisfied, the best illuminant a room could have would be gained by forming the ceiling of a huge parabolic mirror, at whose focus the light source could be placed. By this means the dilation of the pupil, due to the light source, would then be at its maximum point, the largest possible cone of rays would enter the eye, and the arrangement be, therefore, perfect; it is, however, unnecessary to do more than touch upon this idea, the realisation of which is, of course, impossible; but it shows that so far from the light source being as brilliant as possible, it is really desirable that the reverse should be the case, *provided that no more than the required area be illuminated.* This brings the author to the next stage of the article.

It would, from what has been written, seem that as the final * emissive light source should be theoretically infinite in extent, in accordance with fixed conditions already laid down, all data on the subject would be useless; but on the second thought, it will be seen that this is not so, for not only are the hypothetic conditions impossible, but, moreover, as the only substitute lies in the employment of screening or dispersing apparatus, such as reflectors or globes, and these of only limited extent, it becomes necessary to have some method whereby it would be possible to calculate the requisite sizes of these for given purposes. This could be done by simple calculations, based, in the case of mirror reflectors, upon optical laws, and in the instance of globes, upon the law of inverse squares. This is rendered the more necessary on account of the disparity existing between light sources, which renders the calculations suitable to one quite erroneous in the case of another. It is with this view that the author has been led to devise an apparatus which he proposes to term the *optometer*. This instrument, an illustration of which appears in fig. 10, is intended to measure the final efficiency of a light source, or, more correctly, to be used with the photometer in arriving at the final result. It is one thing to have a naked arc giving 1,200 candle-power, but quite another for this high efficiency to be utilised in a manner proportional to its great luminosity, so that a high efficiency at the photometer does not necessarily imply the same thing when the lamp is fixed in its place; consequently the usefulness of this instrument will be obvious. It consists of a tube (preferably furnished with the object glass and eye-piece of a telescope), J. Immediately in front of this is placed a pair of smoked glass wedges, Z F, which can be adjusted so as to cut off any desired percentage of the light passing through them, and thence to the eye piece.

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* By the final emissive source is intended the surface of the reflector or globe for use when the light is unbearably bright.

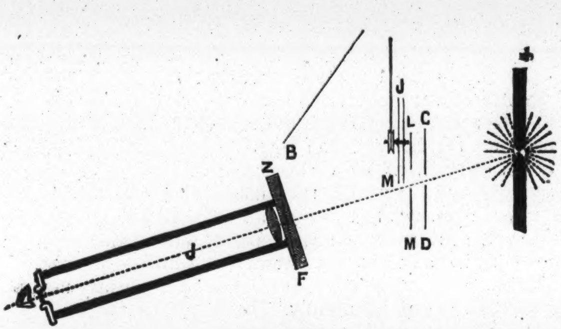


FIG. 10.

The arc, or other luminous source under examination, is removed to a distance of about 10 feet. A screen, C D, is so arranged, that the surface of the radiant is visible through a small perforation at its centre. A mirror, B, is arranged so that it is out of the field of the telescope, while at the same time it reflects a fair amount of light upon the screen, C D; this latter is furnished with several lines about a quarter of an inch in width, which are painted upon its surface with a good dull black pigment (it should be explained that this latter is an important qualification). All being so arranged, the eye is applied to the telescope and the light source viewed through the perforated screen. A diaphragm of blackened card, L M, is now intercepted between the first diaphragm or screen and the telescope; this has an aperture of such a shape that through the perforation in the first screen (through which the light source is seen) only a piece of the screen of the shape shown in fig. 11 is visible. A sector disc, J M, similar to that described several times in these articles is now placed before the screen, C D, so that its outer circumference falls on the line, L M, which coincides with the circumference of the aperture. The portion, L M, P M, of the screen, C D, is then blacked out, leaving merely the aperture and the portion of the disc visible through the opening, K, G, M, L, open to view. The sector disc is then rotated and adjusted until the painted lines upon the screen, C D, are no longer distinguishable, and the adjustment is noted. The disc is now re-opened and the aperture in the screen, C D, closed. It will be seen when the disc is again rotated and the adjustment necessary to extinguish the black lines upon C D noted, that two data are at hand; the first gives the apparent luminosity when the light source is visible, and the second, when this is not the case. Means are therefore at hand whereby it is possible to judge the efficiency of a light source in relation to its brilliancy, and thus it is possible to judge the relative efficiency of modified and unmodified light sources.

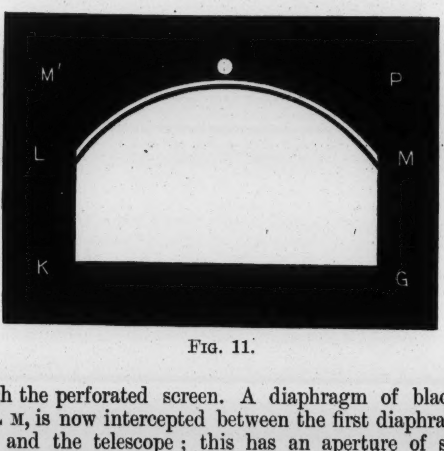


FIG. 11.

When the first measurement is made of the light source visible as well as the illuminated screen, the necessary adjustment is less than when the light source is obscured from view; and as the difference of adjustment is obviously an indication of what may be called the physiological efficiency, it will be seen how valuable are these indications. These indications will be treated with more fulness in the next article.

(*To be continued.*)

POLYPHASED ALTERNATE CURRENTS.

INTRODUCTORY REMARKS.

THE question of polyphased alternate currents has become the topic of the day, and we may say that the application of these currents to the transport and distribution of electrical energy constitutes the really interesting original and novel feature of the Frankfort Electrical Exhibition. But whilst the general attention is attracted by the transmission experiments between Lauffen and Frankfort, there is not sufficient importance attached to the question in its general bearings, *i.e.*, to the employment of polyphased alternate currents as a general method of production, transformation, transport and distribution of electrical energy and its application to lighting, motive power, storage of energy, and electro-chemical operations. The study of polyphased alternate currents includes all these questions, however, and it is with the object of treating them all methodically that we enter upon this series of articles under the general heading of *Polyphased Alternate Currents*, the Lauffen-Frankfort experiments constituting merely one chapter (although certainly the most important one) of this special study.

But, before entering upon our subject, we will show briefly how the increasing progress of electrical industry has led engineers to create a system which four years ago did not exist.

From 1800 to 1830, the date of the discovery of induction by Faraday, the voltaic pile sufficed for electrical researches of a purely scientific character. From 1830 to 1850, during which period we can trace the gradual growth of electrical industry, then limited to telegraphy and electro-chemical operations, the pile was still sufficient for the applications for which it was required. From 1850 to 1870, we find attempts being made to substitute for the battery a more powerful and more economical generator of electrical energy, a continuous current generator. This problem was solved by Gramme in 1870.

From 1870 to 1880 may be called the decade of arc electric lighting, and of the attempts made to obtain small subdivided lights; the incandescence lamp was the solution of this problem. The development and improvement of incandescence lighting occupied from 1880 to 1890, simultaneously with that of the distribution of electrical energy and its transport to great distances. In 1885 began the rivalry between continuous and alternating currents. Whilst continuous currents lend themselves readily to the transmission of power to a distance, they are ill adapted to transformation and distribution at a distance. Simple alternating currents, on the other hand, are well adapted for transport to a distance and transformation, but their application seems limited to thermic effects, such as electric lighting, electric welding, and chemical operations in which the currents act merely as a producer of heat.

We are still in want of a perfect simple alternating current motor and a simple and practical method of transforming alternating currents into continuous currents, which would bring them into general use. While certain inventors were trying to solve these two problems, others, turning to account the magnetic properties of the revolving fields produced by two or more alternating currents with a suitable lag, saw in the methodical and systematic employment of these polyphased currents a means of realising a complete system of generation, transformation, distribution and general application of electrical energy.

It is this system that we propose to study methodically, examining in succession the generators, transformers, motors, and certain apparatus not named up to the present, which form a close bond between mechanical work, electrical energy in the form of continuous currents, and electrical energy in the form of polyphased alternate currents, in the sense that whilst supplying the apparatus with one of the three forms of energy mentioned, it transforms it at will into one of the other two forms, or simultaneously into the two other forms.

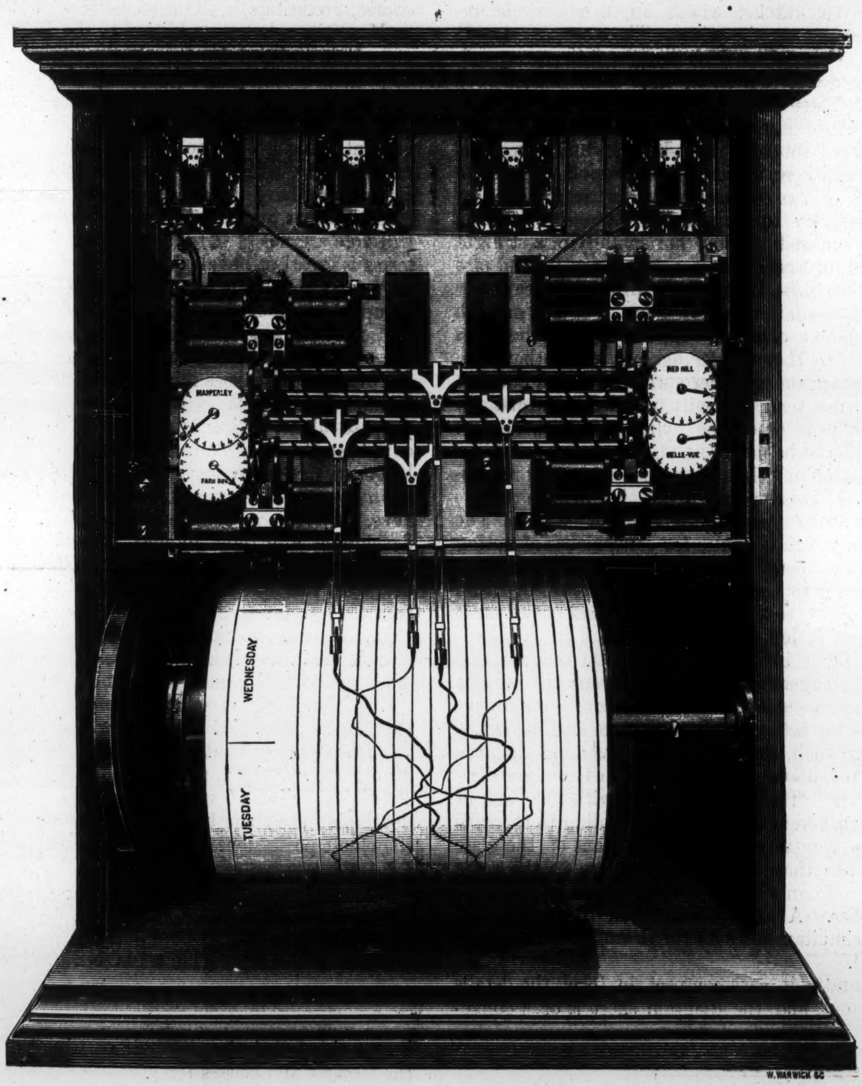
One word more, before we commence our series of articles, as to polyphased alternate currents and their industrial future. As far as we know at present, polyphased alternate currents constitute the most general solution of the industrial employment of electrical energy; in fact, they constitute the only possible solution in cases where it is required to transmit energy to a great distance and to utilise it, for instance, in lighting a town and in a distribution of power service.

But if these currents constitute *at present* the most general solution, it does not follow that this would always be the case. Researches are being made in different quarters, with the object of constructing a simple alternating current motor starting with a load and possessing the same properties as continnous current motors. Other inventors are endeavouring to construct apparatus capable of practically transforming, under good conditions of efficiency, simple alternating currents into a continuous current. These problems are as yet only imperfectly solved, but if better solutions were arrived at, polyphased alternate currents would disappear to give place to simple alternate currents.

Whilst waiting for this, we will consider the case as it stands at present and devote some pages to the general study of these currents, avoiding as far as possible, questions of precedence, which are continually cropping up in this particular case, and which, as matters now stand, are very difficult to decide.

E. H.

(*To be continued.*)



THEILER'S ELECTRICAL WATER LEVEL RECORDER.

The large system of electrical water level indicating apparatus with which the reservoirs and pumping stations of the Nottingham town waterworks have for some years been fitted,* has recently been improved by the addition of a recording apparatus. This apparatus, which has been designed and manufactured by Messrs. Theiler and Sons, under the immediate superintendence of the Postal Telegraph Department (by whom the whole system was designed, erected, and is maintained), is a fine piece of mechanism and a credit to the manufacturers.

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* Electrical Review, June 15th, 1879.

Referring to the illustration, which shows a front view of the apparatus (with the glass door which normally covers the front, removed); at the upper part are four polarised double tongue relays; these relays are severally in connection with unpolarised electro-magnets occupying the middle part of the apparatus. The two tongues of each relay are respectively connected to two electro-magnets, one of which is actuated by a local current brought into action by the movement of one tongue, and the other electro-magnet in like manner by the other tongue. The armature of one electro-magnet has fixed to its end a propelment piece which actuates a ratchet wheel, and on the axle on which the latter is fixed is a second ratchet wheel with its teeth reversed to the first-named wheel. This second wheel is actuated by a propelment piece fixed to the end of the second electro-magnet armature. Positive currents actuate one tongue of a relay and negative currents the other tongue, so that by sending a succession of currents of one kind or the other, the axle on which the ratchet wheels are fixed can be revolved in one direction or the other. There are (as stated) four relays and four sets of local electro-magnets corresponding to the same, and also four axles, each with two inversed ratchet wheels. These four axles, which are seen in the centre of the figure, are each cut with an archimedean screw thread, as shown, and on this thread (of each axle) is a rider from which depends a light rod formed of two German silver wires stiffened by small cross pieces. By turning an axle the screw action causes the rider and rod to move horizontally in a straight line. At the end of each rod is a small pen formed of a short bent piece of glass tube with a drawn out capillary point. These pens contain coloured inks. The pen on each rod having a different coloured ink, the ends of the tubes being bent radially to the cylinder against which they rest, the holes butt against the cylinder surface and the inks the tubes contain do not tend normally to run out, whilst any movement of the pens or of the cylinder causes distinct marks from the inks to be made.

The general action of the apparatus does not require explanation, as it is similar except in detail to the usual working of instruments of a like character. The dials shown are geared to the axles for convenience of noting the positions of the pens without having to observe the latter with reference to the diagram. The recording drum makes one turn in a week, the diagram papers placed on it being ruled for that period.

An important point in connection with the diagram and the pens is the arrangement made to prevent the various pens from fouling one another. It is obviously impossible to have the pens so set that all the points shall be in the same straight line; each, therefore, is set a vertical distance in advance of its neighbour, corresponding to 1 hour's difference on the diagram. The latter is ruled with four sets of hour lines in four different colours, corresponding to the inks in the pens. The lengths of the bent portions of the glass pens are different, so that if all the pens are in the same vertical line, the German silver rods come one over the other and clear each other. A hinged horizontal rod enables all pens to be lifted simultaneously off the drum when the paper has to be changed.

The whole apparatus is very compact in form, the details are well worked out, and the diagram sheet is of a convenient size.

MAURITIUS PAST AND PRESENT.

THE NECESSITY OF TELEGRAPHIC COMMUNICATION WITH ZANZIBAR.

AT the weekly meeting of the Balloon Society of Great Britain, held at St. James's Hall, W., on Friday evening, October 2nd, a paper was read by M. H. Bonnefin, M.R.C.S., England, L.R.C.P., London, on the above subject. Mr. W. H. Le Fevre, C.E., in the chair. After giving an historical and geographical description of the island, the lecturer stated that Mauritius is at the present day the only important colony of the British Empire deprived of the advantages of telegraphic communication with the other countries. The nearest telegraph stations are Natal and Zanzibar; efforts have from time to time been made to establish a cable connection with these points. In 1873 the colony entered into a contract to this effect with Hooper's Company, which was never carried out. The sum of Rs.100,000 per annum was voted by the colony, but this amount did not suffice. A proposal was submitted by the Telegraph Construction and Maintenance Company in conjunction with the Eastern Telegraph Company, comprising a connection with Mauritius, but the Imperial Government, whilst giving a subsidy for the Aden and Natal Cable, declined to give any assistance whatever to establishing communication with Mauritius. Last year, by the aid of the Imperial Government, the cable was laid from Halifax to Bermuda, thus placing the authorities at home in direct communication with that most important dockyard and naval station. The Post Office have now invited tenders for the construction of a line to Mauritius from the East Coast of Africa direct to the Seychelles and thence direct to Mauritius; this will, of course, necessitate a slight deviation from the direct route to Mauritius; but the addition to the length of the cable is more than justified by the consideration that it will result in placing the outlying dependency of the Seychelles in direct communication with the Government at Port Louis nearly a thousand miles away. No specific subsidy is offered, the amount being left to the parties tendering. It is hoped that no difficulty will arise upon this point as the Mauritius Legislature have practically agreed to give a subsidy of £7,000 a year, and it is anticipated the Seychelles Dependency will vote a grant of £1,000 a year. Any failure to come to terms is greatly to be deplored, for the imperial importance of the proposed cable is beyond question. The strategic position occupied by Mauritius is one of immense value. It stands in mid ocean at a point 2,400 miles distant from Aden, 2,340 miles from Cape Town, and 2,040 miles from Ceylon, and in the event of hostilities might command the commerce of the Indian Ocean. It is obvious enough then, for military purposes alone, taking into account the rapid development of our Australasian Colonies and Indian Empire, that it is no longer desirable to leave so important a station dependent upon the postal service as at present is the case. It may have, too, from a commercial point of view, the effect of developing a greater interest here at home in a delightful colony. I therefore trust that the present Government will deal with this question fairly, and that in the event of the contract requiring a vote from Parliament, the House of Commons will sanction the completion of the lines of that electric chain which will bind the Mother Country with one of the oldest and most loyal colonial possessions.

The following resolution, proposed by Mr. J. Esnay (Mauritius), seconded by Mr. S. A. Jackson (Hong-Kong), was adopted:—"That the proposed cable from Zanzibar to Mauritius, *viâ* the Seychelles is of imperial importance in a strategical point of view, and will also have the effect of developing the trade between the Mother Country and one of the oldest possessions of the British Empire."

THE NEW INSTALLATIONS OF THE MONTEFIORE ELECTROTECHNICAL INSTITUTE.

SINCE the foundation in 1883 of the Montefiore Institute, the lectures and classes for practical study have been attended by 201 pupils, among whom we find 111 Belgians, 28 Italians, 13 Dutchmen, 7 Spaniards, 6 Brazilians, 6 Russians, 5 Frenchmen, 5 Englishmen, 3 Germans, 2 Americans (U.S.), 2 Austrians, 2 Argentines, 2 Bulgarians, 1 Greek, 1 native of the Dutch West Indies, and 1 of Nicaragua.

Owing to the increasing number of new members each year (this year they amounted to 33), the first installations of the Institute, became quite insufficient for the practical experiments which play a very important part in the instruction given.

Moreover, the continual progress made in both the science and the application of electricity, necessitated modifications and a considerable extension of the installations; it became necessary to supply the workshop, the laboratories, and the rooms devoted to experiment and research with material and apparatus that would enable the relation to be maintained that should exist between the experimental work and the study of the science which is becoming more complete each year.

Taking these considerations into account, and following the example of M. Montefiore, the Belgian Government has just placed at the disposal of the Institute the spacious building in the Rue St. Gilles, formerly known as the *Ecole normale des Humanités*, together with the funds necessary to keep it up. M. Montefiore, also, has again come forward, and with even more munificence than before, has furnished the new Institute with installations far more complete and important than the first ones.

These installations, which have been carefully studied by Professor Eric Gerard, director of the Institute, whose competence is well known, are now in course of construction, and will be finished in time for the reopening of the Institute during this month.

We propose to give a detailed description of them, but we think it will be in accordance with the wishes of our readers if we first give a brief sketch of the arrangements of the new institute.

The excellent report that has been published by M. Bertolini regarding the institute renders it unnecessary for us to enter into details with regard to the instruction given in this school.

We will merely mention that independently of the general technical instruction, two special courses of lectures are given, viz. :—

1. The advanced theoretical course of electricity and magnetism, which is completed by the study of methods and appliances for measurement.

2. The electro-technical course, sub-divided as follows :—(*a*) The study of current generators and transformers. (*b*) The application of electrical energy to lighting, to the transmission of power, to traction, and to metallurgy. (*c*) The examination of systems enabling communication to a distance to be carried on.

The characteristic of the instruction at the institute is the great attention given to practical work. The rule is to employ in this manner at least one whole year without reckoning the time occupied in attending lectures. This work includes the workshop routine, elementary measurement, photometric measurements, trials with primary and secondary batteries, generators, continuous current and alternating current motors, transformers, and, lastly, special studies and researches.

This branch of instruction is carried out in the rational order indicated above, and this entails an extension of the special installations, so that each may suffice for the requirements of all the pupils in one year.

On the ground floor are the lecture room, the conference hall, the director's office and the museum (salle des collections). The whole of the basement is occupied by the workshop, which is amply provided with all the smaller mechanical appliances. In one of the wings are the rooms for trying small dynamos, motors, transformers, &c. The more powerful machines are worked by a steam engine in another wing, and in others are the service dynamos, the boilers, &c.

The museum contains a very complete collection of measuring instruments, which are placed at the disposal of the pupils for their experiments and special studies, and also a large number of models used for demonstration at the lectures. It also contains the library of the Institute, the works in which are consulted by the pupils.

In the workshop are all the implements used for working wood and metals : lathes, saws, drill, forge, carpenter's tools, &c. Each pupil has his own vice and tool chest. The mechanical machines are driven by two electro-motors of two horse-power each.

One of the machine rooms is reserved for continuous current dynamos, and the other for alternators. The motive power used for their working consists of 10 horse-power electromotors, and they are also provided with transmission and absorption dynamometers.

The dynamos of more than 10 horse-power are tried in the engine room, where a horizontal steam engine of 30 horse-power and an electre-motor of 20 horse-power are installed, which are capable of driving a transmission shaft either singly or together. By means of a special arrangement allowing of a variation of 20 per cent. in the speed of the motive machines, this shaft, which is furnished with a system of pulleys decreasing in diameter, allows of all the trial dynamos being driven at any speed included in a very wide range.

In order to give the pupils an idea of a distribution of electrical energy, the machines used for the lighting of the Institute and for the driving of the electrical motors in the various parts of the building, are in a separate pavilion. These machines, two in number, one a steam engine of 15 horse-power, the other a gas engine of 10, drive dynamos which charge a powerful battery of accumulators in which is stored up the energy required for the lighting, the motive power, and the various laboratory operations.

A tubular boiler of 70 m^2 of heating surface[*] produces the steam consumed by the engines and effects the heating of the building.

These installations will enable the pupils to become familar with the working of steam engines and generators, and to make trials of their regularity, efficiency and consumption. The laboratory for scientific measurements is on the first floor ; it is divided into a series of compartments. This arrangement has the advantage of separating the various groups of pupils so that they do not interrupt one another. The laborotory also comprises rooms for electro-chemistry and chemistry, a room for the preparation of batteries, and a room for photography in which experiments in registering are carried on.

On this floor there is also a room for photometry, provided with various types of photometers, and rooms for the study of the various standards. These latter rooms are devoted to the graduation of the measuring instruments and to their comparison with the standards.

The second floor is more exclusively reserved for the researches made by the professor, his assistants, the more advanced pupils, and non-members of the institute who, in consideration of their knowledge of some special branch, may be authorised by the director to pursue their investigations with the help of the facilities afforded by the Institute. It contains, besides other rooms, a very large hall in which experiments requiring considerable space can be performed.

The conference hall already mentioned will contain the library of the Association of Electrical Engineers, and will be used for the monthly meetings of the association. From this brief sketch our readers will be able to form some idea of the advantages gained by the additions made to the installations and material of the Institute. We will not here discuss the instruction given. Suffice it to say that those who have had an opportunity of appreciating its great value, have left the institute with the conviction that the confidence of the Government could not be better placed than in the eminent professor who had assumed the task of directing this instruction. Specialists turned out by the Institute, heartily applaud the sacrifices made in its behalf by the State and by Senator Montefiore.

THE PROGRESS IN THE ART OF MODERN INCANDESCENT LIGHTING.[†]

By Dr. L. K. BOHM.

THE state of the art prior to the commercial introduction of the incandescent lamp in 1880 will be shortly reviewed only, because the art, up to that time, was practically in an experimental condition, and with but few exceptions, which will be later mentioned, had not left the laboratories of scientists and inventors.

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[*] This boiler was the gift of M. Pièrre Brouhon, the Liège manufacturer, whose reputation is well known. M. Brouhon, by selecting the locomotive type of boiler, has shown that he shares the opinion that this is the one best suited to cases in which space is limited, and one in which economy in construction is combined with economy in the consumption of fuel. Each newly patented type of boiler has its supporters, who extol its merit with all the energy called forth by their interest in its success. The comparative abandonment of Leguin's boiler as a fixed generator is, no doubt, attributable to the fact that few boiler makers are capable of constructing it. The Institute is greatly indebted to M. Brouhon for his liberality ; and the engineer will find great significance in the choice of type made by so competent a constructor and by one whose sole object was to choose for the best.

[†] New York *Electrical World*.

The principle of producing light by incandescence, according to Dr. Werner Siemens in Berlin, was first demonstrated by Prof. Jacobi, of St. Petersburg, before 1840. This scientist is known to Americans as the builder of the first electric boat, which he exhibited on the river Neva in Russia about 1837. King, in his English patent of November 4th, 1845, describes carbon in vacuo. In the same year Grove, the inventor of the Grove cell, published in the *Philosophical Magazine*, vol. xxvii., an account of his incandescent platinum lamp which he had constructed in 1840. Prof. J. W. Draper experimented in 1847 with incandescent platinum, and the results are described in *Silliman's Journal*, second series, vol. iv., 1847. De Changy in 1852 tried to subdivide the current, and produced light by incandescent platinum spirals. He had a patent granted to him in Belgium. According to Mousson's "Physik," Dr. H. Geissler invented the first mercurial air pump as early as 1858. During July, 1859, the house of Prof. Moses G. Farmer, of Salem, Mass., was lighted by incandescent platinum lamps; so he declared as late as October 30th, 1879. About 1860, Dr. H. Geissler invented the celebrated electrical tubes bearing his name. In 1864, Sprengel invented his mercurial air pump. Lodyguine, a Russian physicist, constructed a lamp with two carbon rods in an exhausted chamber in 1873, and the following year he was awarded a prize for his researches on that subject by the Academy of Sciences of St. Petersburg. His carbons were made thinner, *i.e.*, of smaller diameter, and consequently of higher resistance in the place to be heated up to incandescence. Konn, in 1875, made lamps with thin carbon rods in an exhausted chamber, fig. 1. Three of these lamps were burned in the linen stores of Mr. Florent in St. Petersburg for two years. The current was furnished by an Alliance machine. Florent said that he used the electric light of Konn, although it was rather expensive, because it was so clean and his linen did not turn yellow, as it did when gas was used. The two last-mentioned lamps are described in Dr. H. Schellen's "Die neuesten Fortschritte, &c.," 1880, and "L'eclairage Electrique," by du Moncel, Paris, 1880. Bouliguine soon replaced the fine carbon rods of Konn by a thin long carbon. The electricians of the United States Torpedo Station at Newport, R.I., in 1876, produced light by rendering incandescent thin slips of platinum or iridium. Hiram S. Maxim constructed, in December, 1877, a platinum lamp with a thermostatic circuit regulator to prevent the fusion of the platinum burner. The patent was issued September 30th, 1881. Sawyer and Man, in 1879, experimented with carbon rods in artificial atmosphere. After the air was excluded from the glass chamber such gases as cannot combine chemically with carbon were introduced—as, for instance, nitrogen and hydrogen. In the course of these experiments they heated carbon rods to incandescence in an atmosphere of illuminating gas, of hydrocarbon gas, and in a bath of hydrocarbon liquid. These experiments led to the remarkable and, in the manufacture of incandescent lamps, indispensable process known in our days as the flashing or treating. A patent was granted to them for this invention, January 7th, 1879. During 1877 and 1878 William Crookes made experiments on radiant energy, by which he tried to prove the existence of a fourth state of matter, and on April 19th, 1878, he published in the London *Engineering* a description and illustration of a radiometer, which was provided with a platinum ring inside the glass globe under a little flywheel. This platinum ring, when incandescent, maintained the little wheel in continuous revolution (figs. 2 and 3). Crookes's radiometers were all very highly exhausted. Lamps constructed by Lontin and Fontaine did not present noteworthy features. Reynier and Werdermann constructed lamps on a principle known as the Werdermann system. A slender carbon rod presses against a heavy disc of carbon making actual contact, but the lamps are not arc lamps, and are not exactly incandescent lamps. Werdermann lamps were used at the Kensington Museum in London, and the way in which the current was distributed is very interesting. Fig. 4

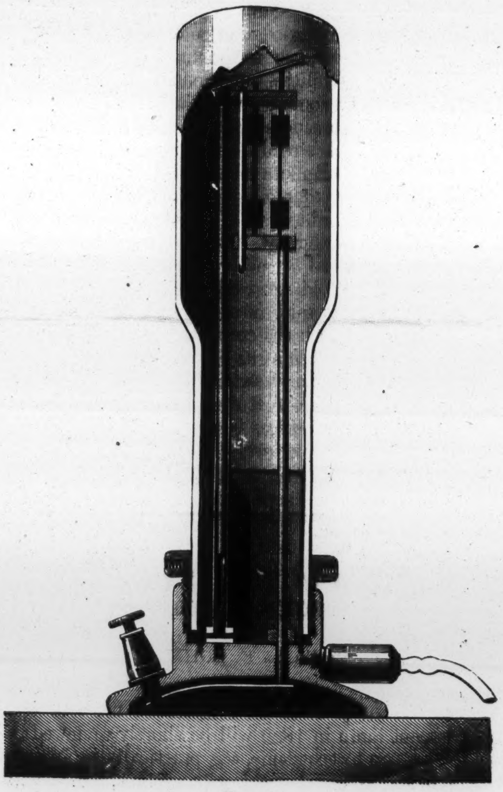


Fig. 1.

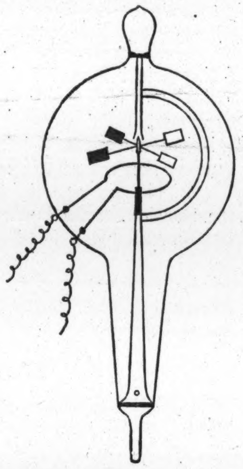


Fig. 2.

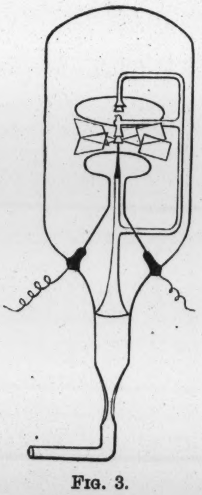


Fig. 3.

explains itself. The ten lamps are placed in multiple arc with a slight resistance each. *La Lumière Electrique*, of July 15th, 1879, page 72, says the light had been of an agreeable softness and steadiness. The current was furnished by a Gramme machine designed for electroplating. On October 5th, November 14th, and December 3rd, 1878, Edison filed three applications for incandescent platinum lamps with thermostatic regulators on the same principles as Maxim's lamp of December, 1877. Lane-Fox on October 9th, 1878, filed a provisional specification for incandescent platinum lamps of high resistance for parallel distribution. (Lane-Fox English patent, No. 3,988, of 1878). Edison, on April 21st, 1879, filed an application for a patent for an incandescent platinum lamp of high resistance for parallel distribution. The burner consisted of platinum wire wound on a cylinder of lime. The patent was issued March 8th, 1880, and a French patent was granted to him May 28th, 1879. These two lamps, one of Lane-Fox, and one of Edison, are the first high resistance lamps for parallel distribution, and as Edison describes and claims a hermetically sealed vacuum chamber made entirely of glass, it is necessary that we examine the specification and drawing of that patent a little closer. A passage of the specification reads: "The drawing shows a section of the apparatus, in which B is the transparent bulb. This bulb is open at the smaller end, and the burner, *d*, inserted, and the open end of the tube is placed in connection with a mercury vacuum pump, the platinum wires, *g* and *f*, passing through. . . . When the vacuum is considered practically perfect, the open end of the tube is melted and sealed. The platinum wires passing through the glass are also sealed." How is it possible to seal "the open end of the tube," through which the burner was inserted, after a vacuum is created? When were the platinum wires sealed? The passage quoted indicated that the wires were also sealed after the vacuum was created, and that is an impossibility and absurdity, because the pressure of the atmosphere will, in every instance, force holes into an exhausted glass chamber when so much heat is applied as is necessary for sealing the wires. And one skilled in the art will not be able to make such a lamp according to that description. Further, the lamp does not constitute a modern commercial incandescent lamp, in that it has, of course, a platinum burner in place of a carbon filament. Fig. 5 shows a plug inside the glass chamber, which presses against the lower narrower part of the chamber, and so holds the lime cylinder with platinum burner in position. This plug is not hermetically sealed in the glass by fusion, while a modern commercial incandescent lamp consists of two essential parts, viz., (1) the outside part or globe or bulb; (2) the inside part or support with burner attached to the platinum wires, sealed in the inside part. Both are hermetically sealed or joined by fusion prior to the creation of a vacuum.

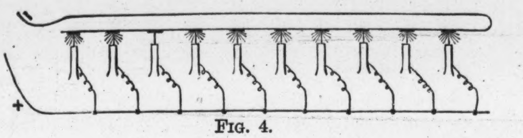


FIG. 4.

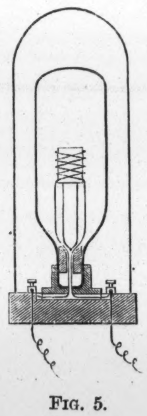


FIG. 5.

The latter part of 1879 brought the experiments with high-resistance carbon filaments, but before entering upon that subject we will look back and see what vital or essential parts or elements of the modern lamp had been developed by this time. The modern lamp, as stated above, consists of two parts—the glass globe and the inside part with sealed-in wires, to which the incandescent conductor is attached; both are hermetically sealed by fusion of the glass prior to the creation of the vacuum. The latter is made as high as practically attainable. We have seen that Geissler had invented in 1858 his mercurial air pump, and Sprengel, in 1874, the tubular mercury pump. The apparatus for producing high vacua were there, and were before 1879 so perfect that Geissler could make spark tubes and Crookes his researches on the fourth state of matter. It was only a matter of manual skill to produce high vacua. The spark tube or vacuum tube, as it is also called, is a plain Geissler tube, so highly exhausted that a spark from a Rhumkorff coil, say two inches long in the open air, would not pass any more between the electrodes, although they were often only one millimetre apart. (Fig. 6.) Such a tube, sealed on a mercury air pump, was often used to determine the degree of exhaustion. Then it was called a vacuum tube or vacuum gauge. If the rarefication had reached a certain point then say a one-inch spark would not pass any more, but if a two-inch spark was then employed the tube was illuminated again. Carrying on the exhaustion further, the two-inch spark would not pass any more, and so forth. Such vacua and those employed in Crookes's radiometers are higher than the vacua found in incandescent lamps to-day. The spark tube presents another important feature. It is an all-glass closed chamber, with leading-in platinum wires, sealed in by fusion of the glass, the same way as is done with all Geissler tubes. Lane-Fox and, later, Edison—not to speak of Werdermann's distribution of current—recognised the importance of high-resistance filaments to be used in multiple arc, and the Crookes radiometer with the platinum ring had every element of the modern lamp in it, arranged in a different way and for a different purpose.

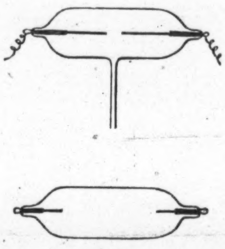


FIG. 6.

To review, there was at that time:—

1. The all-glass closed chamber, with leading-in platinum wires, sealed in by fusion of the glass (Geissler tubes, radiometers).
2. The high vacua and the apparatus to produce them (spark-tube, radiometer, Geissler-pump, Sprengel pump).
3. High resistance filaments for parallel distribution (platinum filaments, Lane-Fox, Edison).
4. The incandescent platinum ring in combination with an all-glass closed chamber with leading-in platinum wires in a high vacuum (one style of Crookes's radiometers).

What had to be done now to make a commercial incandescent lamp after all the mentioned essential elements of the lamp were known? Incandescent conductors had to be invented of such a nature and such material as would make the lamp durable and economical enough for commercial use. This was the state of the art and the condition of experimenters when the author of this article became an assistant of Mr. Edison about the middle of August, 1879, in his laboratory at Menlo Park, N.J. In 1877 and 1878 I had been the pupil and assistant of Dr. Geissler in his private laboratory at Bonn, on the Rhine. I not only knew the Geissler tubes and radiometers, but had made myself all sorts of Geissler tubes and numerous experimental radiometers. I knew the Geissler pump and its manipulation, for I had exhausted all the experimental radiometers myself; I had, in other words, produced numerous high vacua. At Edison's laboratory I had to make first mercurial air pumps, and soon succeeded in making them of high efficiency by combining the Géissler and Sprengel pump. In testing such pumps a vacuum was produced, in one instance so high that the spark of a Ruhmkorff coil 9 inches long in the open air would not pass the spark gauge. (See *Scientific American*, January 17th, 1880.)

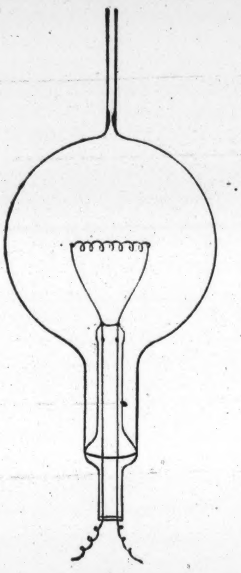


Fig. 7.

The next step taken in Edison's laboratory was the production of a platinum lamp. (Fig. 7.) I gave the lamp the shape of a radiometer for the very plain reason that I had made numerous radiometers. It was the easiest way for me to do. I only put the platinum spiral in the place where the little wheel is on the radiometer. The narrow tube for connection with the air pump was exactly in the place where it was put on a radiometer, and the lamp was exhausted like a radiometer. This lamp was the first lamp made in Edison's laboratory that had all the elements of the modern commercial lamp, arranged as they are in lamps to-day. The inside part with the leading-in wires I made separately. That part of the work then passed into the hands of Mr. Batchelor, Edison's most skilled assistant, who mounted the platinum spiral. Then I sealed the inside part with the spiral fastened to it in the globe by fusion of the glass, prior to the creation of the vacuum, and the lamp was then exhausted. By comparison with the Crookes radiometer it is plainly seen that both contain, except the wheel, exactly the same elements, but differently arranged. After the lamp was exhausted it was sealed off in the same way that Geissler tubes and radiometers are sealed off. Meanwhile, Mr. Edison himself was very busy with his European telephone, the chalk buttons of which caused so much trouble, and Mr. Upton had the dynamo built.

Next the carbon spiral turned up. This was made of thread coated with lampblack and tar. The lamp with this spiral was made like the lamp with the platinum spiral; in fact, Edison's lamp has not changed in appearance since. except that for long filaments an elongated glass bulb was and is used to-day. On October 22nd, 1879, the first lamp with a carbonised paper hoop was made, and on November 4th Edison applied for a patent for a lamp with a carbon filament of high resistance. On December 21st, 1879, the New York *Herald* published an account of Edison's successful lamps, at the same time these lamps were on exhibition at Menlo Park. Meanwhile Swan made experiments with incandescent lamps with carbon filaments, and Maxim was perfecting the hydrocarbon treatment by means of which a hard surface of carbon is deposited on the baked filament in order to make the filaments of uniform resistance. At first the filaments were fastened to the platinum wires by clamping devices. Edison very early fastened them by depositing copper in the place where the filament was held by the flattened end of the wires. This method, which was used for several years, is now considered worthless, because the deposit of copper contains air, which can never be driven out during the process of manufacture, because it is impossible to heat the portion with the copper deposit to incandescence. Other inventors fastened the filaments to the wires by putting on mechanically little particles of mixture of finest carbon powder, India ink, and sugar solution, &c. Sometimes these little particles are heated to incandescence in a hydrocarbon gas or liquid so as to ensure perfect contact. The best method, however, for high resistance filaments is to clamp them in little tubes which form the ends of the wires and then plate them. The filament is placed in hydrocarbon liquid and is cut out of the circuit so that only its ends next to the platinum tubes, one-eighth of an inch long, are rendered incandescent together with the part in the tube. Carbon is deposited only at that point and fills up the little tubes and so "cements" the filament to the wires. Some first enlarge the ends of the filament in a similar way by cutting the filament out of the circuit and depositing carbon on the ends, then the flattened ends of the wire are heated around the enlarged ends of the filament. To get good contact it is also necessary to cement them. The cementing has to be done before treating. There is no air in such an electrolytic deposit of carbon for cementing, because the part where the deposit is made is kept incandescent while the deposition is made, consequently all gases are driven out. The mass of the deposit varies with the current consumed by the lamp. Fig. 8 shows the parts of the modern lamp with filaments variously arranged.

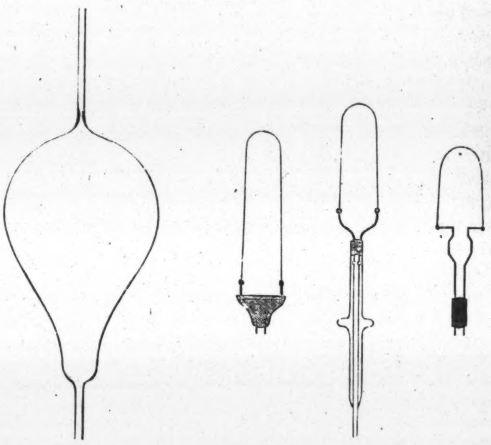


Fig. 8.

A lamp of a different construction was patented by the author in the latter part of 1880. This lamp consisted of two parts like the modern lamp, but the two parts were not sealed together by fusion nor was the lamp sealed off after the creation of the vacuum. The inside part was ground airtight into the lower open end of the bulb, as gas stopcocks are ground, and the exhausted chamber was closed by turning the inside part about 180°. Alexander Bernstein made hollow carbons in 1881, and later he made lamps with short, thick filaments of carbon for use on arc light circuits in series. These lamps meant a most remarkable step in the progress of the art of incandescent lighting, because they were especially well adapted for high candle-power lamps. They are manufactured by various companies, and on an extensive scale by the Bernstein Company, of Boston.

As before stated, Maxim was perfecting the processes and methods of the hydrocarbon treatment, and he succeeded well. The first commercial plant of this successful lamp was started November, 1880, in the Equitable Building, 120, Broadway, New York. The successful operation of these lamps with filaments prepared in a hydrocarbon atmosphere proved beyond doubt that the commercial incandescent lamp was invented, a lamp that was uniform in resistance and candle-power, and could be manufactured and sold because it was reliable. Of course, practice had to develop details, and skilled labour for manufacturing large numbers had to be educated.

(To be continued.)

LONDON COUNTY COUNCIL.

AT the weekly meeting, held on Tuesday last, the following report was presented:—

NOTICES UNDER ELECTRIC LIGHTING ORDERS AND ACTS.

We have to report that we have, acting upon the authority conferred upon us to deal with matters during the recess, sanctioned the works referred to in the undermentioned notices:—July 28th, 1891, from the Metropolitan Electric Supply Company, of intention to lay mains in Suffolk Street, Pall Mall East, Cockspur Street, and Trafalgar Square, west side. August 13th, 1891, from the Notting Hill Electric Lighting Company, of intention to lay mains in Holland Park; and August 15th, 1891, from the same company, of intention to lay mains in Pembridge Place and Crescent.

The works proposed were of very small extent, and it was intimated to the companies concerned that, subject to the usual conditions, they might be proceeded with. We recommend that the council do ratify the action taken by us with reference to these notices.

We have also considered a notice from the Notting Hill Electric Lighting Company, without date, but received at this office on August 29th, 1891, of intention to lay mains in Pembridge Gardens and Square. There appears to be no objection to the proposed works; and we recommend that the sanction of the council be given to the works referred to in the notice, without date, of the Notting Hill Electric Lighting Company, upon condition that the company do give two days' notice to the council's chief engineer before commencing the work; that the cover stones of the culverts under 20 inches wide shall be not less than 2 inches thick, and of the wider culverts not less than 2½ inches; and that where the culvert crosses the carriageway, there shall be at least 9 inches' thickness of Portland cement concrete above the cover stones of the culvert, in addition to the road material.

We have considered two notices from the Westminster Electric Supply Corporation, one dated August 25th, 1891, of intention to lay mains in Sussex Street, Cumberland Street and Westmoreland Street, and the other, dated September 9th, 1891, of intention to lay mains on the west side of Regent Street, from Conduit Street to St. George's Church. The proposed works are unobjectionable, and we recommend that the consent of the council be given to the works referred to in the notices, dated August 25th and September 9th, 1891, respectively, of the Westminster Electric Supply Corporation, upon condition that the company do give two days' notice to the council's chief engineer before commencing the works; that the mains be laid under the footways wherever it is found practicable to do so; and that the covers of the street boxes to be used shall consist of iron frames filled in with material to suit the paving.

The House-to-House Electric Light Supply Company has served a notice, dated September 1st, 1891, of intention to lay a main across Earl's Court Road at Earl's Court Gardens. There seems to be no objection to this proposal, and we recommend that the sanction of the council be given to the works referred to in the notice, dated September 1st, 1891, of the House-to-House Electric Light Supply Company, upon condition that the Company do give two days' notice to the council's chief engineer before commencing the work; that no pipes of a larger diameter than 6 inches shall be used; that the street boxes to be used shall be of the pattern approved by the council; and that as an additional precaution against accident through defective insulation of the mains, each of the street boxes shall be provided with an inner as well as an outer cover, each insulated from the other as far as practicable, and that the outer cover shall be efficiently connected with earth.

A notice, without date, was received on September 2nd, 1891, from the Kensington and Knightsbridge Electric Lighting Company, of proposed extension of mains in Brompton Road, from Montpelier Street to Fulham Bridge Road. These works are of the ordinary character, and we recommend that the sanction of the council be given to the works referred to in the notice, without date, of the Kensington and Knightsbridge Electric Lighting Company.

The London Electric Supply Corporation has given a notice, dated September 5th, 1891, of intention to lay two lines of distributing mains, consisting of concentric lead-covered cables in iron pipes, in Tooley Street and Montague Close, Southwark. There appears to be no objection to what is proposed, and we recommend that the sanction of the council be given to the works referred to in the notice dated September 5th, 1891, of the London Electric Supply Corporation, upon condition that the company do give two days' notice to the council's chief engineer before commencing the works; that the mains be laid under the footways, and be kept 9 inches below the under side of the paving, wherever it is found practicable to do so; that, where the mains cross the carriageways, they be kept at the same depth below the concrete or the road material, as the case may be; that all pipes or openings from or into the boxes shall be of such shape as to remove all risk of injury to the covering of the cables; that all cables crossing the boxes shall be supported from below in the boxes; that all service lines or small cables shall be protected where leaving the boxes by an extra lead covering, or by wooden stoppers, and shall also have a copper wire of sufficient size carried from the service to the main cable, in good connection with the lead or iron outer casing; and that the ends of all mains terminating elsewhere than in a box shall be securely protected by iron caps, in addition to any other covering.

We have considered two notices, dated September 1st and 11th, 1891, respectively, from the St. James and Pall Mall Electric Lighting Company, of intention to lay mains (1) across Regent Street, to complete the scheme of mains approved by the council, and (2) to connect two mains in Regent Street already authorised. The works referred to are of the usual character, and there appears to be no objection to them. We recommend that the sanction of the council be given to the works referred to in the two notices, dated September 1st and September 11th, 1891, respectively, of the St. James and Pall Mall Electric Lighting Company, upon condition that the company do give two days' notice to the council's chief engineer before commencing the works, and that the works in Regent Street, referred to in notice No. 240, shall, when commenced, be carried on continuously by day and night until completed.

A notice dated September 23rd, 1891, has been given by Mr. H. Robinson, on behalf of the Vestry of St. Pancras, under the St. Pancras (Middlesex) Electric Lighting Order, 1883, of intention to lay mains in Park Street, Camden Town, Gordon Street and Square, Woburn Square, Tavistock Square, Endsleigh Street, and Upper Woburn Place (1 plan). The proposed works are similar to those previously approved by the council in the application of the vestry, and, seeing no objection to them, we recommend that the council do approve the works referred to in the notice of the Vestry of St. Pancras, dated September 23rd, 1891, under the provisions of the St. Pancras (Middlesex) Electric Lighting Order, 1883.

We have considered a notice, dated September 24th, 1891, from the Metropolitan Electric Supply Company, of intention to lay mains in Kildare Terrace, Talbot Road, Westbourne Park Passage, Orchard Street, Alfred Road, Bradley Place and Street, Harrow Road (part of), and Amberley Road (part of). The proposed works are of the same description as those of this company previously sanctioned by the council, and there seems to be no objection to them. Part, however, of the route to be traversed by these mains consists of narrow alleys, and the company should be required to provide that a thoroughfare shall be kept there while the works are in progress. We recommend that the sanction of the council be given to the works referred to in the notice dated September 24th, 1891, of the Metropolitan Electric Supply Company, upon condition that the company do give two days' notice to the council's chief engineer before commencing the works; that provision be made for the works to be carried out in the narrow ways included in the notice without stoppage of the traffic; that the mains be enclosed in iron pipes or efficient casing, and be laid under the footways wherever it is found practicable to do so; that as an additional precaution against accident through defective insulation of the mains, each of the street boxes shall be provided with an inner as well as an outer cover, the two insulated from each other as far as practicable, and that the outer cover, which shall consist of an iron frame, filled in with material to suit the paving, shall be efficiently connected to earth.

We have also to report the receipt of the following notices given in accordance with the resolution of the council to accept four days' (instead of one month's) notice in respect of the laying of service lines from mains already laid:—From the St. James and Pall Mall Electric Lighting Company—July 30th, 1891—To 8, Pall Mall, and No. 50, Glasshouse Street. August 21st, 1891—To 7, New Burlington Street, 174, Piccadilly, 163 and 230 Regent Street. August 26th, 1891—To 77, Jermyn Street, 10, Sackville Street, and 10, St. James's Square. September 1st, 1891—To 182, 218, and 232, Regent Street. September 8th, 1891—To St. James's Palace. September 8th, 1891—To 167, 193, 230, and 232, Regent Street. September 11th, 1891—To 90, 198, and 206, Regent Street. From the Electricity Supply Corporation—July 31st, 1891—To the St. Martin's Vestry Hall, Charing Cross Road. August 29th, 1891—To 4 and 6, Charing Cross Road. September 21st, 1891—To 29, Spring Gardens. From the Westminster Electric Supply Corporation—July 28th, 1891—To 11, Halkin Street West. July 28th, 1891—To 13, Half Moon Street. (No date)—To 1, St. George's Road. From the London Electric Supply Corporation—July 24th, 1891—To 146, Borough High Street. July 24th, 1891—To 77, Southwark Street. July 25th, 1891—To 121A, Regent Street, and 41 and 42, Parliament Street. July 29th, 1891—To 235, Westminster Bridge Road. July 29th, 1891—To Garrick Chambers. July 31st, 1891—To 143, 413, and 487, Oxford Street. August 18th, 1891—To Hibernia Chambers. August 20th, 1891—To 43, Upper Brook Street, and 47, New Bond Street. August 21st, 1891—To 2, Tooley Street. August 21st, 1891—To 62, South Audley Street. August 28th, 1891—To 233, Borough High Street. September 2nd, 1891—To 24, Haymarket. September 25th, 1891—To 23, Haymarket. September 25th, 1891—To 1, Rupert Street.

ELECTRIC TESTING STATION—METER INSPECTOR.

We have to report, for the information of the council, that Mr. W. Arnot, who was appointed in February, 1890, at a salary of £200 a year, to act as an inspector under the Electric Lighting Orders and Acts, has resigned his appointment, he having been appointed electrical engineer to the Glasgow Corporation. We have made temporary arrangements for the discharge of the duties, and propose at a future time to advise as to the manner in which the vacancy shall be filled.

Pneumatic Tubes.—Messrs. Blakeney and Rennie, of Glasgow, invite attention to their new system of pneumatic carrying. They use a new tube which is stated to give excellent results, and with the other details and improved apparatus they are enabled to instal their system at a very low rate. They supply pneumatic tubes 1½ inches diameter up to 100 feet long for transmitting written matter, papers, &c., with pump, automatic signaller, and carriers. A small extra charge is made for erection. Messsrs. Blakeney and Rennie also erect motors at reasonable figures.

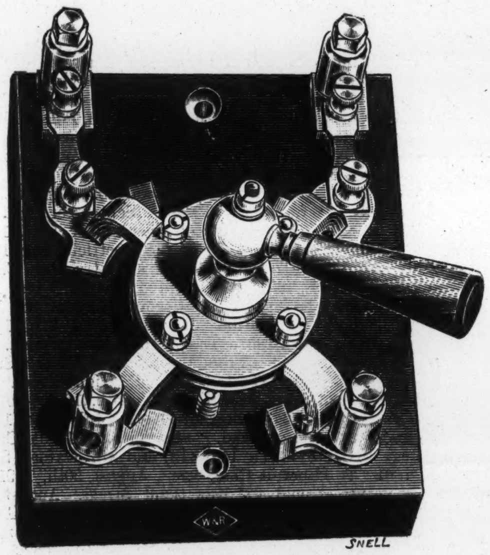
NOTES.

Improved Postal Facilities in Philadelphia.—It has been decided by Postmaster-General Wanamaker to have the first official test of the pneumatic tube system made in Philadelphia. The system has long been advocated in New York, and it is believed will greatly facilitate the distribution of mails in large cities.

Consulting Electrical Engineering.—Mr. Morgan Williams, A.M.I.C.E., M.A., formerly installation engineer to the Electrical Power Storage Company, and the Electric Construction Corporation, has now entered into partnership with Mr. Frank King, M.I.E.E., and the firm are practising as consulting electrical engineers under the title of Messrs. Morgan Williams and King, at 39, Victoria Street, Westminster.

The Electric Lighting of the Vienna Town Hall Clock.—In the early part of last month (September) the clock of the Vienna Town Hall was for the first time illuminated by means of electricity. From sunset to midnight the dial is now illuminated by 32 incandescent lamps of 16 C.P., current for which is supplied from the installation in the Town Hall. The dial of the clock has a diameter of 10¾ feet, and the numbers denoting the hours have a length of 1 foot 10¾ inches, while the length of the minute finger is 7½ feet.

Double Pole Switches.—Messrs. Woodhouse and Rawson have lately introduced types of double pole switches which combine on one base and with one movement, the action of two separate ordinary switches. Our illustration shows the form given to those intended for ordinary electromotive forces. It is "quick break," the handle is fitted loosely and powerful springs come into play and break both circuits simultaneously. Care is taken to insulate the two circuits completely from one another.



Electric Lighting at Portsmouth.—The Electric Lighting Committee have decided to consult Prof. Garnett before any further steps are taken. Under the low tension system the cost of feeding the mains alone was estimated at £18,000, and the total cost at about £60,000. The Committee have received an offer from a firm of high standing to execute the same work for £38,000 at high pressure in the mains and low pressure outside by means of transformers, this figure to include everything. The high pressure system would be advantageous from more than one point of view, as the position of the generating station is not essential, and only moderate sized feeding mains are necessary, so that with the station at the water side coal could be brought right into the yard and the expense of cartage saved. The whole matter is in abeyance until the report of Prof. Garnett has been received.

Barrack Lighting.—Estimates have been forwarded to the Admiralty of the cost of lighting the Sheerness Royal Naval Barracks with the electric light.

Electric Tramways in Genoa.—The municipality of Genoa proposes to establish several electric tramways in that town, and a request has been forwarded to Parliament asking that such lines should be declared of public utility.

Electric Lighting in Tiverton.—The Town Council have under consideration a proposal to light the streets by electricity. Recently several members of the Council visited the electric lighting works at Taunton, and were favourably impressed with all they saw.

Australian Postage Rates—Result of Reduction.—The New South Wales postal authorities have prepared an estimate of the effect of the reduced rates of postage to the United Kingdom on the postage receipts. Last year, when the 6d. rate was in force, the loss on the federal mail service was £563, whilst this year it is expected, under the 2½d. rate, to be £12,725.

England and the Postal Union.—The Swiss Federal Council has notified to the French Government that England has given her adhesion to the Postal Convention of June 1st, 1878, for her colonies of New South Wales, Victoria, Tasmania, New Zealand, and New Guinea. This adhesion will become effective from October 1st.

Lighting St. George's Hospital.—Messrs. Drake and Gorham have been engaged in designing a special arrangement for the electric lighting of the operating theatre and other parts of St. George's Hospital. The current will also be used for electric cautery and other purposes. This firm should be thoroughly conversant with the requirements of a London hospital, as Mr. Drake was compelled to spend some months in a hospital elsewhere owing to his accident, from which we understand he has entirely recovered.

South Metropolitan Gas Company and Street Lamps.—At the St. George's Vestry, Southwark, on Tuesday, and at St. Saviour's Board of Works, Southwark, on Wednesday, letters were read from the South Metropolitan Gas Company announcing that although the price of gas was to be raised from 2s. 3d. to 2s. 6d. per 1,000, the charge per annum to local bodies for the gas supplied to street lamps would not be increased. The opinion is freely expressed in the district that the fact that the London Electric Supply Corporation is rapidly covering the district with its mains has assisted the South Metropolitan Gas Company to come to this decision.

The Working Speed of Telegraphic Apparatus.—The following figures, says *Bulletin Internationale l'Eléctricité*, are the results of experiments at the Ministère des Postes et Telegraphes, Paris. The messages are taken to consist of twenty words of 7·5 letters each:—

Apparatus.	Nnmber of messages per hour.	Number of operators.	Number of messages per hour per operator.
Morse	25	2	12·5
" duplex	50	4	12·5
Sounder	40	2	20
" duplex	80	4	20
" quadruplex	110	8	20
Wheatstone	100	10	10
" duplex	200	18	11
Delany quadruplex	160	8	20
Baudot "	160	10	16
Hughes	50	4	12·5

With reference to these results, we would remark that they may possibly be such as have been obtained with experimental apparatus; but, as a matter of fact, there are no Delany or quadruplex circuits in France, and the figures as practical results are therefore worthless. Again, the figures obtained with the Wheatstone are either incorrect or indicate that the proper working of the apparatus is not understood, and that it is worked at a speed absurdly below what it is capable of.

"Copper" Insulation.—One of our American contemporaries states that the following is going the rounds at the New York Electric Club :—"Why does a policeman sometimes wear rubber boots ?—To insulate the 'copper.'"

Sale at West Drayton.—A sale is to take place at the Mart, on the 14th inst., of the buildings of the Alliance Engineering Works, West Drayton, including all the machinery, erecting shops, boiler house, cottage, stabling, &c., which are all to be sold in one lot.

Electric Light at Eastbourne.—The Floral Hall of the Devonshire Park, Eastbourne, is now lighted by 16 sunbeam lamps of 200 C.P. each, the current being supplied from the mains of the Eastbourne Electric Light Company, Limited. The lamps being of frosted glass, a beautiful soft light is produced. The hall was formerly lighted by arc lamps, the current being supplied from the plant of the Devonshire Park Company.

Steam Power in Germany.—At the commencement of the present year, 731 stationary engines of 38,344 H.P., and 63 portable engines of 1,266 H.P. were in use in Germany for driving electric light dynamos. There were also 177 fixed engines of 9,697 H.P., and 12 portables of 212 H.P. in operation for actuating dynamos for other purposes. The highest percentage was in Berlin, where 16·07 per cent. of the total was employed. Water power occupies but a very inferior position for electrical purposes at present.

Electric Light in Old Kent Road.—A considerable portion of Old Kent Road is in the parish of St. George the Martyr, Southwark, though practically cut off from the Borough end by an intervening strip of Newington. Consequently, while many houses in the Borough and Newington Causeway are lit by electricity, Old Kent Road is not in a position to adopt the light because the London Electric Supply Corporation's mains are not yet laid in that district. We are informed that one large trader in Old Kent Road has resolved not to wait for the extension of the mains, but to purchase his own dynamo.

Electric Miners' Lamps.—Some interesting trials have been carried out at the Rochebelle Mines with electric safety mining lamps by a committee appointed by the French Société de l'Industrie Minerale. Four types of secondary battery lamps, the Pollak, Edison, Breguet, and Stella, were employed. Weight is an important factor in the question, and it was found that the Pollak lamp weighed 4·18 lbs.; the Edison, 24·2 lbs.; the Breguet, 6·38 lbs.; and the Stella, 3·08. The Edison is far and away too heavy, though it gives the best light, viz., about 2½ candle-power, but this is not required for mining purposes. The conclusion come to by the committee is that the most suitable mining lamps of the four are the Breguet and Stella, but that the former has certain faults, which can, however, be readily remedied.

The Lauffen-Frankfort Experiments and the "Petit Journal."—The Paris *Petit Journal*, the daily circulation of which exceeds 1,000,000, is singularly well informed by its scientific correspondents, as we may judge from the following extract :—"The last act of the Frankfort Electrical Congress has just been played at Lauffen. The principal members have visited personally the falls of the Neckar, in order to examine the volume of water utilised. Notwithstanding the diminution effected by lessening the speed of the machines, it was found that the turbine still absorbed 200 horse-power. The motive force consumed at the exhibition by the pumps supplying the cascade cannot be estimated at more than 30 or 40 horse-power. It is true that the current also supplies 1,000 lamps, but these are kept incandescent without any intermediate mechanism being employed. We are therefore justified in saying that the experiment, although interesting, is far from fulfilling the promises made in the programmes which were scattered broadcast before the opening of the exhibition. The poles decorated with death's heads have not yet brought to Frankfort the last news concerning the transport of energy to a distance." Thus, according to the learned (?) correspondent of the *Petit Journal*, the 1,000 incandescence lamps, as they require no mechanism, do not count. Truly, the science of political journals is a wonderful thing.

Alteration of Address.—Messrs. Frank Suter & Co. announce that they have removed from 276, Strand, W.C., to more convenient premises at 66, Berners Street, W.

Institute of Medical Electricity, Limited.—At the last meeting of this company it was agreed that the institute be wound up voluntarily, Mr. J. W. Biggs being appointed liquidator.

Telephones in Ecuador.—The only town in Ecuador possessing a system of telephonic communication is Guayaquil, which has a telephone exchange supported by about 400 subscribers.

The Electric Light in the Strand.—The new establishment of Messrs. Mansfield, bootmakers, in the Strand, is being fitted with the electric light by Messrs. Woodhouse and Rawson.

The Electric Light in Canada.—Another Canadian town—West Toronto Junction—has adopted the electric light, an order for plant to supply 500 16 C.P. lamps having been given to the Heisler Electric Light Company.

Sevenoaks Lighting.—The Board of Trade have proposed to the Sevenoaks Local Board that the provisional order obtained by the Electric Trust, Limited, shall be revoked. The Trust asked for the order to be renewed for another year, and this is the result.

Obituary.—We regret to have to record the death of Mr. Charles Herbert Orwin, chief electrician to the India and Panama Telegraph Company, which took place on his way home to England from St. Thomas. Mr. Orwin was only 38 years of age.

The Electric Light in Copenhagen.—The electric central station at Copenhagen is, according to the *Elektrotechnische Zeitschrift*, approaching completion. The mains are already laid, and the dynamos, made by Siemens and Halske, are on the spot, waiting their being put in position.

Electric Signalling in Australia.—It is said that the South Australian Railway Commissioners are making enquiries into the cost of adopting Spagnoletti's system of electric signalling between the passengers and the engine drivers on their lines.

Telegraphs in Norway.—The receipts from the telegraphs in Norway during the year 1889-90 amounted to £59,512, while the expenditure was £66,370, showing a loss of £6,858. During the whole of the period, 1880 to 1890, the telegraphs have been a source of loss to the country.

Electric Light for Dover.—The Town Council decided on Tuesday to accept the Brush Company's tender for street lighting. The cost of the street lamps will be £650, or about 50 per cent. more than is paid for gas. A local company will be formed to carry out the contract.

Electric Light at Lisbon Opera House.—The Portuguese Government has declined to continue to pay for the electric lighting of the Lisbon Opera House, which amounts to over £6,000 a year, or to contribute towards any other system of lighting. The Government never was under an obligation to pay for the lighting as it has done hitherto, and it is stated that the electric method is being found too costly, while the laying down of gas pipes would amount to a still greater sum.

Electric Lighting of Bray.—The whole of the town of Bray, known as "the Brighton of Ireland," is to be lighted by electricity. Messrs. J. E. H. Gordon & Co., Limited, of 11, Pall Mall, have secured the contract, and have put the work in hand. The principal streets are to be lighted with arc lamps and the rest with incandescent, and the mains for the supply of current for private lighting will be laid at the same time. The electricity will be generated by water power situated in the town. The system to be used will be the same as that which Messrs. Gordon & Co. are carrying out at the Crystal Palace, namely, direct current with motor transformers and storage batteries.

Tenders Wanted for Lighting St. Helen's Town Hall.—The Parks, Market, and General Purposes Committee desire tenders for supplying machines for the lighting of the Town Hall. Fuller information may be obtained from our advertisement columns.

The Belgian Technical Press.—Three Belgian technical journals, *L'Ingénieur-Conseil*, *L'Industries Modernes*, and *Industria*, have recently combined their interests, and from the 1st inst. the combination will appear as one journal, under the title of *L'Industrie*. We wish the new departure every success.

Projected New Submarine Cable.—A Washington telegram states that a submarine cable will shortly be laid between Pernambuco and Senegal. The project is being promoted by an English company, and, unless unforeseen difficulties arise, it is announced that within six months the cable will be open for traffic.

Tramway Tender Wanted.—The mayoralty of the township of Galatz (Roumania) is desirous of making a concession for the construction of a tramway line in the town, and invite any who may wish to undertake the matter to see or obtain the conditions and terms at the mayoralty. This is a first-class opportunity for electrical firms to put forward tenders for the work with electricity as the motive power.

City and Guilds of London (Session 1891-2).—A special course of evening instruction for beginners, on the "Differential and Integral Calculus and its application to the Practical problems of Mechanical and Electrical Engineering," will be given at the Technical College, Finsbury, Leonard Street, City Road, E.C., by Prof. John Perry, M.E., D.Sc., F.R.S. A good working knowledge of the elementary principles of algebra and trigonometry is expected in students, and those who are unable or unwilling to devote at least two hours at home to working the exercises which will be set will not derive much benefit from this course of instruction. A lecture will be delivered every Tuesday evening, from 7.30 to 9 p.m., commencing October 13th.

Manchester Electric Lighting.—The arrangements for installing the electric light in the central portion of the city are in a forward state. It is, of course, impossible yet to form an opinion as to the extent of the demand there will be for the electric light, and it has therefore been decided to adopt a size of unit of supply plant such as will certainly be required, and which can be added to by duplication from time to time as the demand increases. One engine with a large dynamo machine will deliver at the station 250,000 watts, and to the consumer from 200,000 to 250,000 watts, according to the distance from the station. It is proposed to have three such sets of plant in the first instance, two working and one in reserve, and the building will be so arranged that the plant may be readily increased to a total of twelve sets. In order that unnecessarily large engines may not be used when they are not needed, a smaller set of plant will be brought into use during the time when the demand for the electric light is small. From the generating station the electricity will be conveyed on what is known as the five-wire system, and while the supply will be at 400 volts, it will be available for those who desire it at 100 volts, so that the consumer who uses a large number of lamps and wishes to wire his premises economically, will be able to make use of 400 volts, and consumers who require to turn out their lights separately will make use of 100 volts. With regard to the price of the new illuminant it is not yet possible to say anything definite, as the matter is still under consideration. Probably the average price will be about equivalent to the price of gas. If the light is charged at the rate of threepence per unit the cost would be equal to the price at which gas is sold in the city, and it could be produced at less than this if the demand were continuous and steady for ten hours per diem. But some consumers will only take their supply for an hour or so per day, and that at the busiest time, and from such consumers little or no profit will be made even at the maximum charge of eightpence per Board of Trade unit. With the view of encouraging the continuous use of the light, it is proposed to adopt a graduated scale of charges.

Fort Salisbury Telegraph Line.—The British East Africa Chartered Company has just forwarded 114,000 lbs. of telegraph wire to complete the telegraph to Fort Salisbury.

Overhead Systems of Electric Traction.—In his October report on tramway and brewery securities, Mr. W. W. Duncan speaks in favourable terms of the decision to use the overhead system of electric traction on the lines of the South Staffordshire and Birmingham District Tramway Company. While in the United States recently, he was informed that the saving in working cost by electric traction, as compared with horse-power, was about 3d. per mile run. If this can be effected on the lines in question, the result, he says, "will be most satisfactory to the long-suffering shareholders of that company."

Electric Poacher Poaching.—The *Daily Telegraph* brings to notice a novel and curious application of the electric light. It has now become a poacher detector. The gamekeepers on an estate near Bournemouth found that poachers were in the preserves, and by the aid of occasional flashes from the search lights at Hurst Castle, they were able to recognise two men who ran away, leaving behind them a net a hundred yards long. They were afterwards arrested, from the description given by the keepers, and brought before the Bournemouth magistrates, who sentenced them to two months' hard labour and to find security for good behaviour during twelve months, or in default suffer six months' additional imprisonment. Hurst Castle is several miles distant from the place where the men were identified. "Is it possible," the *Telegraph* asks, "to establish on lofty monuments in the metropolis, strong electric lights which could be utilised for the identification of burglars and other unlawful depredators, who may manage to escape capture?" All who live within search-light shot of Chelsea have found that the thing is, alas, only too possible; and are wishing for the good old burglar days again.

Electric Belts in Court.—It would appear that it is only necessary to bring the purveyors of electric belts into court for their wares to lose repute. The following case may be interesting to our readers, as showing the foolishness of the ever gullible public, and the character of the dealers of these so-called remedies. The case came before Judge Bayley in the Westminster County Court on Wednesday. The plaintiff, Miss Livers, sued three gentlemen, including Dr. Carter Moffatt, trading as the Magneto-Electric Battery Company at the Imperial Mansions, New Oxford Street, to recover £10 as damages for fraudulent representation. Mr. Horace Browne was counsel for the plaintiff, and Mr. Wildey Wright for the defendants; while Mr. De Wette held a watching brief for persons interested. Mr. Wright said he was instructed late on Tuesday night, and he understood that the same evening the defendants' solicitor wrote to the plaintiff's solicitor, and said the money would be paid into Court, and the action not defended. He hoped no one would think that the defendants admitted the alleged fraud. The fact was that they had no time to prepare their case, and as the letter had been written defendants must abide by it. Mr. Browne said that as his client had succeeded he asked for costs upon the higher scale, as the matter was one of great importance to the general public. The grounds were that one of the defendants—the only one whose name appeared to the public, Dr. Carter Moffatt—was represented to be a duly qualified man, which was not correct. Mr. Moffatt was not a doctor, and had no right to pose as such. The circular issued by defendant suggested that Mr. Moffatt was a duly qualified man to practise in ailments of this kind. He had witnesses present to speak to the manufacture and effect of the belts. The actual cost of the belt, which was called the "Belt of Life," was 3s. 9d. Mr. Wright said the "B.H.D." to Mr. Moffatt's name was a German distinction, and he in no way professed to be a doctor. He asked his Honour not to grant the application, because if he did it might prejudice the action now pending as to the infringement of rights between Mr. Harness and the defendants. There was no admission of fraud. His Honour: I think it is a case where I am at liberty to certify. It is a question of general public interest. The money was then paid into court, and an order for costs upon the higher scale. Vendors of such belts may expect scant mercy whenever they appear before intelligent judges.

Maidstone Factory Lighting.—The Maidstone Jam Factory is being fitted up with the electric light apparatus by Messrs. R. Dann, of High Street, Maidstone.

Gravesend and Telephony.—The Gravesend Town Council are in negociation with the National Telephone Company with the object of introducing an efficient system of telephones into the Gravesend district.

NEW COMPANIES REGISTERED.

Richard S. Hughes, Limited.—Capital, £15,000 in £10 shares. Objects: to acquire and take over as a going concern the business carried on by R. H. Hughes, at Nos. 95, 96 and 97, Hatton Garden and Robin Hood Yard, E.C.; to adopt an unregistered agreement with R. S. Hughes for the purpose, and to carry on the business of gas and electrical engineers and fitters, manufacturers of chandeliers, electroliers, and of gas and electric lighting fittings and appliances, lamp makers, &c. Signatories (with one share each), R. S. Hughes, 5, Mount Park Crescent, Ealing (gas and electrical engineer); D. J. Sadler, 5, Marlborough Road, Upper Holloway; G. Russell, 67, Barset Road, Nunhead; J. L. Warby, 6, Little Sutton Street, Goswell Road, E.C.; W. Morriss, 24, King Edward Street, Islington; H. C. Parsons, 3, Ash Grove, Cricklewood (electrician); E. J. Sibley, Brayville, Belmont Road, Tottenham. The number of directors shall not be more than four, the first being R. S. Hughes, and F. Stileman, who are entitled to retain office for twelve years. Remuneration, £250 per annum for each of the above, and after two years that of F. Stileman will be increased to £300 per annum. R. S. Hughes is chairman and managing director. Office: 96, Hatton Garden, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Byng Telephone Company, Limited.—The following notice from J. P. Spencer, 32, Moseley Street, Newcastle, the liquidator of the above company, was filed on the 2nd inst:—"To the Registrar of Joint Stock Companies,—I beg to inform you that a general meeting of the above-named company was held on September 17th, for the purpose of having laid before it an account showing the manner in which the winding up of the said company had been conducted and its property disposed of, and of hearing any explanation that might be given by the liquidator. I have further to inform you that the notice calling the meeting was duly published in the *London Gazette* of August 14th, 1881, and that a circular notice was also sent to each member, together with a copy of the liquidator's report and a copy of the statement of accounts."

Liverpool and District Pulsion Telephone Company, Limited.—The statutory return of this company, made up to July 8th, was filed on July 14th, 1891. The nominal capital is £6,100, divided into 6,000 ordinary and 100 founders' shares of £1 each. 100 founders' and 4,080 ordinary shares have been taken up, and upon 1,080 ordinary shares 5s. per share has been called and paid, with the exception of £12 10s. The founders', and 3,000 of the ordinary shares are considered as fully paid. Office, C., Queen Insurance Buildings, Liverpool.

National Telephone Company, Limited.—The annual return of this company, made up to June 30th, 1891, was filed on the 29th ult. The nominal capital is £4,000,000, divided into £30,000 preference shares of £10 each and 740,000 ordinary shares of £5 each. All the preference and 447,234 of the ordinary shares have been taken up, the full amount per share called and paid, amounting to £2,536,170. Office, Oxford Court, Cannon Street, E.C.

Laing, Wharton and Down Construction Syndicate, Limited.—The annual return of this company, made up to August 10th, 1891, was filed on the 8th ult. The nominal capital is £40,000, in £100 shares. 399 shares have been taken up, and upon 266 the full amount has been called and paid. The remaining 133 have been considered as fully paid. A notice that the nominal capital has been increased by £60,000, to be divided as the directors may deem expedient, was filed on August 29th, 1891.

W. T. Henley's Telegraph Works Company, Limited.—The annual return of this company, made up to the 1st ult., was filed on the 21st ult. The nominal capital is £70,000 in £10 shares, of whioh 6,697 have been taken up, the full amount called, and £66,700 out of £66,970 paid. Office, 27, Martin's Lane, E.C.

Electric Welding Company, Limited.—The office of this company is now situate at 2, Tokenhouse Buildings, E.C.

"Eclipse" Electric Lighting Syndicate, Limited.—The registered office of this company is situate at 2, Pancras Lane, Queen Street, E.C.

CITY NOTES.

Brazilian Submarine Telegraph Company, Limited. The accounts of the Brazilian Submarine Telegraph Company, subject to audit, show a profit sufficient to enable the directors to recommend a final dividend of 1s. per share, making with previous distributions a total dividend of 6 per cent. for the year ended June 30th, 1891, and also the payment of a bonus of 4s. per share, both free of income tax, which together will amount to £32,500, leaving a balance of £88,210 16s. 9d., of which amount £60,000 has been placed to the reserve fund, increasing that fund to £474,878 7s., and £28,210 16s. 9d. carried forward. The very exceptional increase in revenue mainly arises from the disturbed state of affairs in South America. For the purpose of paying the above dividend and bonus on the 22nd inst., the register of transfers will be closed from the 12th to the 21st inst., both days inclusive.

The European Sims-Edison Electrical Torpedo Company, Limited.—The prospectus of this company has just been issued, the capital being £201,000 in 10,000 ordinary shares of £20 each, and 1,000 founders' shares of £1 each. The company has been formed to work the inventions relating to the Sims-Edison electrical torpedo for the whole of Europe, India, and all the British colonies. The vendors take 3,333 ordinary shares in part payment of the purchase money, and the balance of 6,667 are offered for subscription.

Submarine Cables Trust.—The Submarine Cables Trust announces that on and after the 15th inst. the balance of the coupon due in April last—viz., £2—will be paid by Messrs. Glyn, Mills and Co., of Lombard Street, between the hours of 10 a.m. and 2 p.m. The coupons should be left with the bankers for examination four clear days before payment.

National Telephone Company, Limited.—The directors of this company have made a new issue of 4½ per cent. debentures to provide capital for further extensions and improvements of the system. It was offered to the present shareholders at £105 for each £100, and it has been largely over applied for.

International Okonite Company, Limited.—The International Okonite Company, Limited, notifies that the first annual general meeting has been postponed from Friday, the 9th inst., and will be now held on Wednesday, the 14th inst., at the Cannon Street Hotel.

The City of London Electric Lighting Company, Limited.—Colonel Ben Hay Martindale, C.B., has been elected a director of the City of London Electric Lighting Company, Limited.

TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ended October 2nd, amounted to £5,226.

The City and South London Railway Company. Traffic receipts for last week amounted to £748 gross.

The Cuba Submarine Telegraph Company, Limited. The estimated traffic receipts of the Cuba Submarine Telegraph Company, Limited, for the month of September, were £3,000, as compared with £2,997 in the corresponding month of last year.

Direct Spanish Telegraph Company, Limited. The estimated traffic receipts for the month of September, 1891, are £2,004, as against £2,526 in the corresponding period of last year.

The Eastern Extension, Australasia, and China Telegraph Company, Limited.—The traffic receipts for the month of September amounted to £40,586, as against £43,938 in the corresponding period of 1890.

The Eastern Telegraph Company, Limited. The traffic receipts for the month of September were £56,589, as against £55,346 for the same period of 1890, an increase of £1,243.

The Great Northern Telegraph Company. Receipts in September, 1891, £24,000; 1st January to 30th September, 1891, £213,400; corresponding months 1890, £206,800; corresponding months 1889, £203,200.

The West Coast of America Telegraph Company, Limited. Traffic receipts for the month ending September 30th, 1891, were £3,650.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 2nd, 1891, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Company were £4,100.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (Oct. 1st, 1891.)	Closing Quotation. (Oct. 8th.)	Business done during week ending (Oct. 8th, 1891.)	
					Highest.	Lowest.
250,000*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	99 —102	99 —102	...	...
1,300,980*l*	Anglo-American Telegraph, Limited	Stock	48 — 49	48½— 49½	49½	48¾
2,849,510*l*	Do. do. 6 p. c. Preferred	Stock	87 — 88	87½— 88½	88⅞	87⅝
2,849,510*l*	Do. do. Deferred	Stock	13 — 13½	12¾— 13¼	13⅜	12⅞
130,000	Brazilian Submarine Telegraph, Limited	10	11¾— 12¼	12 — 12½	12⅜	12
53,200*l*	Do. do. 5 p. c. Bonds	100	99 —102	99 —102	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	103 —107	103 —107	...	...
77,978*l*	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3⅜— 3⅝	3⅛— 3⅜	3½	$3\frac{5}{16}$
69,996*l*	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	1⅞— 2⅛	1⅞— 2⅛	$2\frac{1}{16}$	$1\frac{15}{16}$
50,000	City and South London Railway, Nos. 1 to 50,000	10	2 — 4	2 — 4	...	...
$7,716,000	Commercial Cable, Capital Stock	$100	122 —124 xd	122 —124 xd	123⅛	123
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	$\frac{7}{16}$— $\frac{9}{16}$	$\frac{7}{16}$— $\frac{9}{16}$	½	...
20,000	Crompton & Co., Ltd, 7 p. c. Preference Shares, Nos. 1 to 20,000	Stock	5 — 5½	5 — 5½	$5\frac{5}{16}$	...
16,000	Cuba Telegraph, Limited	10	10½— 11½	10 — 11	$11\frac{3}{16}$	11
6,000	Do. do. 10 p. c. Preference	10	17 — 18	17 — 18	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3½— 4 xd	3½— 4 xd	...	...
6,000	Do. do. 10 p. c. Preference	5	9 — 10 xd	9½— 10½xd	10	9¾
60,710	Direct United States Cable, Limited, 1877	20	10⅞— 11⅛	11 — 11¼	11⅛	$10\frac{15}{16}$
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅛— 14⅜	14¼— 14½	$14\frac{7}{16}$	14¼
70,000	Do. 6 p. c. Preference	10	15 — 15½	15 — 15½	15⅜	...
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	107 —110	107 —110	...	...
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	107 —110	107 —110	108¾	...
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	14⅞— 15⅛	14⅞— 15⅛	15⅛	15
78,300*l*	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	104 —107	104 —107	105	...
276,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	104 —107	104 —107	104½	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	106 —109	106 —109	...	...
135,000*l*	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	102 —105	102 —105	...	...
180,400*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	102 —105	102 —105	...	...
201,600*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	99 —102	99 —102	...	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	6 — 6½	7½— 8	7⅞	6½
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ..	...	...
66,750	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	3 — 3¼	2⅞— 3⅛	3	2⅞
70,000	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	4 — 4¼	3⅞— 4⅛	$4\frac{1}{16}$	...
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	2¼— 2½	2¼— 2½	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	2 — 3	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅝— 9⅞	9¾— 10	9⅞	9¾
180,042	Do. do. 6 p. c. Preference	10	14⅞— 15⅛	14⅞— 15⅛	15⅛	14⅞
150,000	Great Northern Tel. Company of Copenhagen	10	18¾— 19¼	18¾— 19¼	18⅞	...
220,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	104 —107	104 —107	...	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	8 — 8½	8 — 8½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	10 — 11	10 — 11	...	...
41,600	India-Rubber, Gutta Percha and Telegraph Works, Limited ...	10	20 — 21	20 — 21	20½	20
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	102 —104	102 —104	...	...
17,000	Indo-European Telegraph, Limited	25	41 — 43	41 — 43	43	42¼
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	7 — 8	7 — 8	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	9 — 9½	9 — 9½	...	...
38,348	London Platino-Brazilian Telegraph, Limited	10	6½— 7½	6½— 7½	7½	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	105 —108	105 —108	107	...
43,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	10 — 10½	9¾— 10¼	10⅜	10
447,234*l*	National Telephone, Limited, Nos. 1. to 438,984	5	4⅜— 4⅝	4⅜— 4⅝	$4\frac{9}{16}$	4⅜
15,000	Do. 6 p. c. Cum., 1st Preference	10	12½— 13	12½— 13	$12\frac{1}{16}$	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	12½— 13	12 — 13	...	...
420,000*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	106 —107	105 —107	106⅜	105¾
6,318*l*	Notting Hill Electric Lighting Company, Limited, £8 paid ...	10	3½— 4½	3½— 4½	...	...
220,000*l*	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	$\frac{3}{16}$— $\frac{5}{16}$	$\frac{3}{16}$ — $\frac{5}{16}$	...	...
9,000*l*	Reuter's Limited	8	8 — 8½	8 — 8½	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	8 — 8½	7¾— 8¼	8½	$7\frac{15}{16}$
7,900	Do. do. do. 7 per cent. pref.	2	6¾— 7¼	6¾— 7¼	$7\frac{7}{16}$	6⅞
3,381	Submarine Cables Trust	Cert.	120 —125	120 —125	120½	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	5 — 5½	5 — 5½	5½	$5\frac{3}{16}$
37,350	Telegraph Construction and Maintenance, Limited	12	42 — 44	42 — 44	43¼	42½
150,000*l*	Do. do. do. 5 p. c. Bonds, red. 1894	100	102 —105	102 —105	...	...
58,000	United River Plate Telephone, Limited	5	2 — 3	2 — 3	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	85 — 95	85 — 95	...	...
3,200*l*	Do. do. 7 p. c. Debs., Nos. 1 to 1,000 ...	100	... ...	... ...	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	8 — 9	7½— 8½	8	...
271,400*l*	Do. do. do. 5 p. c. Debentures	100	96 — 99	97 —100	99½	...
30,000	West Coast of America Telegraph, Limited	10	3¾— 4¼	3½— 4	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	98 —103	98 — 103	...	...
67,007*l*	Western and Brazilian Telegraph, Limited	15	10¾— 11¼	10¾— 11¼	11⅛	11
30,364*l*	Do. do. do. 5 p. c. Cum. Preferred	7½	6½— 7	6½— 7	7	$6\frac{15}{16}$
30,364*l*	Do. do. do. 5 p. c. Deferred	7½	4¼— 4¾	4½— 5	$4\frac{13}{16}$	$4\frac{11}{16}$
189,700*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	102 —105	102 —105	...	...
237,200*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	102 —105	102 —105	104½	...
88,321	West India and Panama Telegraph, Limited	10	1⅝— 1⅞	1¼— 1½	1¾	$1\frac{7}{16}$
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	9½— 10	9¼— 9¾	9⅝	9½
4,669	Do. do. do. 6 p. c. 2nd Preference ...	10	8 — 9	8 — 9	...	...
$1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	120 —125	120 —125	...	...
173,100*l*	Do. do. 6 p. c. Sterling Bonds	100	98 —102	98 —102	...	...
42,853	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5⅞— 6⅛	5⅞—6⅛	6⅛	$5\frac{15}{16}$

* Subject to Founders' Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7¼—7⅜.—City of London Electric Lighting (Pioneer), Shares of £50, fully paid, 60—62.—Ordinary of £10 each, £4 paid, 4⅛—4⅜.—Electric and General Investment, Shares of £5, £1 paid, 1¾—2¼.—Elmore's Austrian Copper Depositing, 15s., 25s., £2 share issued at 10s. prem. fully paid, 1—1¼.—Elmore's Priorities, 3⅞—4⅛.—House to House Company (£5 paid) 4½—5.—Liverpool Electric Supply, Shares of £5, £3 paid, 4⅞—5⅛.—London Electric Supply Corporation, Ordinary (£5 paid), 2—2½.—Manchester, Edison and Swan Company, £9 (£1 paid), ⅜ — ⅝.—National Telephone Debentures, 2½ — 3 prem. —Woodhouse and Rawson Ordinary of £5 (£2 10s. paid), 2⅛—2⅜.—£5 Preference, fully paid 3¾—4.—Debentures 90—95.—Wards Electric Car, £10 paid, ¾—1.

BANK RATE OF DISCOUNT.—3 per cent. (September 24th, 1891).

A CENTRAL STATION COMBINING THE ADVANTAGES OF BOTH THE CONTINUOUS AND ALTERNATING CURRENT SYSTEMS.*

By H. WARD LEONARD.

(*Concluded from page* 393.)

Mr. Leonard: Mr. Smith seems to have made the error of assuming that I am appearing in the *rôle* of an advocate of the three-wire system. If such impression exists, I wish to correct it as promptly as possible. My remarks with reference to the three-wire system and the alternating were such that they would be admitted by almost every one to-day. I presume that any one familiar with the facts would admit that the average efficiency of the three-wire system was higher, that it was conspicuously higher at small loads, and in speaking of the possibilities and advantages of the system which I have proposed, I was only giving consideration to the existing conditions of to-day. First, I will speak upon the points that Mr. Smith has mentioned, as I have noted them. He spoke of the disadvantages of operating the multiple arc system. And yet it seemed as though the universal opinion must be that a multiple arc arrangement of dynamos is preferable to a separate one, when we remember that, in the first part of the business of electric lighting, machines of constant potential were operated on separate circuits, and that they have been gradually placed in multiple arc is due to the advantages gained thereby. I think you will almost never find to-day an isolated plant where we have a large number of machines supplying a constant potential distribution, in which each machine is supplying a separate circuit. The possibilities of regulating and the economies are so much higher when the machines are in multiple arc that, entirely outside of any consideration of central station supply or of the three-wire system, it seems as though the result of experience has been that where machines can be operated perfectly, simply and reliably with multiple arc, it is better to do so. With reference to the question of grounding the neutral wire, I can dismiss that by stating that I agree thoroughly with Mr. Smith that the grounding of the neutral wire is an extremely bad practice, and that there is no argument for grounding the neutral except perhaps that of laziness. As to high pressure primary, the paper which I have read of course bears evidence in itself that I am a thorough believer in the necessity of high pressure primaries for reaching any great distance, and there certainly appears to be an advantage in having those high pressure wires as few in number as possible. And instead of having a complete network through the city of high pressure wires, if we can by any means carry a few of the high pressure wires to centres, there would be less liability to any trouble due to the existence of high pressures. Mr. Smith has mentioned that in his belief an alternating current motor will soon be attained in practice and ready for service. I thoroughly agree with Mr. Smith on this point, and have no doubt that an alternating current motor will soon be ready for commercial service—but how soon is a question. In the meantime the existing condition to-day is that the central station manager cannot secure an alternating current motor to put upon existing circuits, and, in fact, the work which is being done on an alternating current motor thus far is not of a kind to indicate that an alternating motor which can be placed upon the same circuit as an incandescent lamp will result. One point I will state before going further: All of my remarks have been on the basis of the three-wire system merely because of the saving in the cost of conductors which is attained thereby. Were we able to have a 200-volt lamp instead of 110 volts, it would be, of course, infinitely preferable to have the two-wire system and use a 200-volt lamp than to have three wires for a lamp of 110 volts on each side, and, furthermore, the cost would be reduced even beyond that of the three-wire system. As to the sub-station method of operating on the outskirts of the town, that is unquestionably, when the alternating current motor is at hand, a very desirable way of operating. And yet it seems to me that even then, until we have our 200-volt lamp, it will be extremely advantageous to use for distribution something which will enable us to reduce the cost of our conductors on the consumer's premises to a point far below that of 50-volt lamps. As I have pointed out in the paper the cost, at the same distance and at the same percentage of loss in conductors of a three-wire system, will be but one-twelfth that of a two-wire system with 50-volt lamps, and if we had 200-volt lamps, with the two-wire system and our secondary distribution, it would be but one-sixteenth. Consequently when we have delivered our high pressure to the sub-station, and are ready to distribute to our consumers, we would have a very large number of sub-stations in order to operate 50-volt lamps, or else we must have an enormous expenditure in conductors. It seems to me that under the existing conditions it will be well, and indeed the best way that we have at present at command, to use the three-wire system, as it does enable us to distribute from that centre at low pressure and at the least cost. When the time comes that the 220-volt lamp is commercial, the three-wire system will of course still present the advantage of being able to reduce the cost, but the high pressure which will be realised then may be a sufficient argument against the use of 500 volts in the premises of the consumer, and may make the 200 volts satisfactory.

Mr. Smith: I wish to speak first in reply, because I wish to straighten out a little matter between Mr. Leonard and myself which might interfere with the proper carrying on of the discussion afterward. I fully understand Mr. Leonard's attitude in this matter. My remarks about the three-wire system were not made with any idea that Mr. Leonard is upholding it as against the alternating, but because he in his new plan calls for all inside wiring to be done on the three-wire system for lamps of 110 volts. I apparently did not make it clear that the 200-volt direct current in the building is what the insurance people are afraid of now, and that consequently we must abandon that in any new system which is to be an improvement upon that. The use of an alternating current of 220 volts I do not believe would have that disadvantage, and in that case Mr. Leonard's plan would be all right. But as his plan contemplates using during a part of the time a continuous current of 220 volts, I feel that the 220 volts should be barred altogether. Of course on a 50-volt lamp we can use the three-wire systems, and in many cases where buildings have been already wired we may get a proportion of reduction of copper in that way. With regard to the multiple arc I would say that in my experience the multiple arc in isolated work has been used to save the running of new feeders. Where a plant has been wired up throughout and one dynamo installed, and then enough lights put on to take up the whole capacity of that machine, and the customer wants more light, he taps the wires which he has. But when he goes to put on new power he simply couples his new dynamo right into the circuit, just as a man who puts in a new boiler in a steam plant couples in the old steam pipe. If the old steam pipe were too small he would run a new main. And so it is with an electric light plant. Where we instal an isolated plant we always put it so that three or four dynamos can operate, though, as a general rule, they are all in multiple arc. Another reason for operating a multiple arc system is found in the fact that small sizes have been hitherto made in machines. A 1,000-light dynamo is just about as good for practical use, but we have 3,000-light dynamos for the alternating current, and larger ones are to be built and used. In that case I do not think that there can be any question about multiple arcing. With regard to sub-stations, I would say that Mr. Leonard seems to have slightly misunderstood my remark. The sub-stations are not for the purpose of direct supply to the consumer. They are for supplying the sub-mains, which are run at much higher pressure than we would introduce to the customer, and the customer is supplied through a second series. That, of course, gives us the double conversion, and the loss caused by double conversion, as against the loss caused by a single conversion; but it gives us the advantage of running one of those converters always at its highest efficiency, namely, a full load. The whole question, of course, as I have said, comes back to one of interest on first cost, as against loss in feeders. So that in speaking of sub-stations, I do not mean to be understood as saying that there would be an enormous number of sub-stations, but only one for each district.

Mr. Leonard: I think that Mr. Smith has made a very ingenious argument upon the multiple arc question, but I hardly feel that his position is sustained by the facts or by practice. Of course, as he has pointed out, where conductors are placed on one dynamo, and the load gradually increased, they are driven to the multiple arc arrangement, unless they are going to put in new conductors. The fact is, that every large isolated plant that I have ever had occasion to bid on, has been so specified and rated by the common consent of all companies that have entered bids, that the dynamo shall be in multiple arc when there were eight or ten at the beginning, and it is the universal practice in all companies to so design their plants, and hence the multiple arc arrangement is one that has been forced by the unexpected enlargement of the plant rather than by a deliberate design to obtain the best results in the beginning. Mr. Smith has spoken of an arrangement of sub-stations, but he has not yet pointed out how he gets rid of the losses that will occur upon the final converters. He has put in an intermediate set of converters, and has taken means to take out converters as the load diminishes, but his final converters in his distribution throughout the city are still connected, and are the same as we have had before.

Mr. T. Carpenter Smith: I would use the same plan as Mr. Leonard proposes in his system. I would have them grouped and switched in and out by the operator, just as I do in the sub-stations. I am only comparing one system as against the other. With regard to the multiple arc, I will say that I still hold to my proposition that multiple arcing is not put in because it is a great advantage, but it is put in to allow of two machines being connected together. It is a good thing simply because in an isolated plant the conditions are different from what they are in a central station. Your loads are all on one side of the bus bar, and you are required to run two dynamos separately, and it is similar to running them together in the same building. If you take an ordinary building, where, as an ordinary rule, two machines are put in for use against the chances of breakdown, the machines have to run in multiple arc, because the wires are fed from the same feeder. Our alternating station is run in practically the same way, only instead of switching the dynamo out of the multiple arc we switch a feeder into the multiple arc on another dynamo. Our dynamos are united inside of our circuit. In the central station we simply shut down the dynamo, and we transfer the feeder load. I cannot see that running the station in multiple arc is any particular advantage, or that running an isolated plant in multiple arc bears upon the question directly. It is an advantage to run a multiple arc, but in central station work the advantage is not so great as in isolated plants.

Mr. Leonard: I have one further remark to make, and it is this: Mr. Smith explained how he was going to reduce the loss of the final converters of the circuit by throwing off a part of the load when the load became too heavy. This necessarily assumes an arrangement of converters in multiple arc on the secondary which is not contemplated in my scheme, and is not in practice to-day.

Dr. Bell: At the risk of stirring up all parties in this discussion, I want to make one or two suggestions with regard to this scheme, and the first of them is to suggest the question as to whether or not a 220-volt alternating circuit is a pleasant thing to have around the house. I have very grave doubts about that. I am not afraid of the direct circuit of 220 volts, but when it comes to turning loose 220 volts on a three-wire alternating system around and about the house, it seems to me that it is a good thing to avoid. I know that there are plenty of alternating current men who say that they have no fear of a current of 1,000 volts; but in all seriousness I think that 220 volts alternating current is a thing which has got to be handled rather delicately if buildings are to be customarily wired for it. I do not know that there would be any risk to life from 220 volts alternating current, but at the same time I think the public would view the matter with a little doubt. As to the question of alternating currents I think that we ought to remember that on the other side of the water alternating currents are habitually run for the purpose of keeping the whole system loaded to its fullest capacity. We do not happen to do it here, but they do make a practice of it over there, and with great success. As to the reason for it, I think it is all summed up in the saying that it is a good thing not to put too many eggs into one basket. If you have a 100 kilowatt machine, and anything happens to it, the whole station is down right then and there until that machine is fixed. If you have three or four smaller machines, you may be able to crowd on a load and thus keep going. But I have heard grave doubts suggested by those who know Ferranti personally, as to whether he will ever complete those machines. There is such a thing as getting an alternating current so big that you cannot handle it efficiently, and I think that those units of Ferranti come very near that.

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* Paper read before the fourteenth Convention of the National Electric Light Association, Montreal, September, 1891.

Mr. T. CARPENTER SMITH: I have brought a good deal of unpleasant newspaper comment upon myself by certain statements that I have made in public, but I have made those statements, and I am prepared to stand by them, and every experience that I have had since making them has only confirmed my belief. For the whole public I cannot speak, but for a certain small section I can speak. We did have—but have changed them all for other reasons—several buildings in which we had 220 volts of alternating current. The buildings had been originally wired for the three-wire system, but with very small wire. We had to make the change rapidly, and could not take time to increase the size of the wire. We took four 50-volt converters and coupled the primaries in multiple arc, and put secondaries in each system, and put them across the three-wire system. We found that our customers did not object half as much to the 220-volt shock to the alternating current as they did to the 220-volt direct. The shock is undoubtedly a great deal more unpleasant, and for that reason I think it is rather a good thing, for it discourages meddling with the current which the customer is only prone to indulge in. The real danger to life, I think, must not only be taken into consideration in that shock, but the far greater dangers from fire. We have no hesitation in saying, and we do not think there is any insurance man here present who will not agree with the statement, that the danger of fire from an alternating current of 220 volts is not ten but one hundred times less than from 220 volts of the direct. Another thing: Our three-wire stations have developed in practice (although I doubt if any of them would admit it in public) a very easy but very reprehensible practice of burning out their grounds at night. When they discover a ground upon the system they find it easier and cheaper just to switch in three or four big machines and burn it out, finding out next morning where the ground was. That is pretty bad practice as regards the danger to life, and I think very much greater than any chance of any accident arising from a 220-volt shock. I am not contending for 220 volts of alternoting current. I do not like it myself. I am only pointing to the fact that as compared one with the other, if 220 volts of direct has not been found dangerous or objectionable, the 220 volts of alternating will not be found so.

THE S.C.P. MINERS' ELECTRIC SAFETY LAMP.*

BY G. E. SMITH.

IT is claimed for this lamp that it more nearly resembles, in size and form, the ordinary oil safety lamps in general use than any other yet invented. By unscrewing the bottom, the lamp or bulb can be replaced by a new one in a few seconds; and, in the same way, the lamp glass, which is of the ordinary or standard size now in general use, can also be replaced the same as in the oil form of safety lamp. Another feature is that each of the cells composing the battery is separate and independent, and should any accident or fault require one or more of these cells to be replaced, it can (unlike those now in use) be done in a few minutes at the colliery, spare cells being supplied and kept in stock. This fact is of great importance, for in the older forms, if one cell failed the light became dull, and there was no means of telling which identical cell it was; but in these lamps, if any irregularity is observed, each cell can be tested in a few minutes with the voltmeter, and the bad cell taken out and a new one put in, and the lamp sent into the pit as usual, thus saving many extra lamps being required; whereas in the ordinary forms the lamp has to be returned to the maker, causing much delay and expense. This advantage is said to avoid many of the irregularities found in other electric safety lamps.

The cells are made with a special plate, which gives greater electric capacity for a given weight than any other. It has a high charge retaining power, is free from local action and sulphating, and there is little or no deterioration of the plate. There is a plate here, taken from a battery that has been two and a half years in use, which shows how far this statement is borne out in practice.

The battery is of the storage or secondary type, and is contained in a circular metal case, avoiding the use of wood, which has hitherto been too prominent a feature in electric miners' lamps. There are two small studs, called charging points, marked + and −, at which the dynamo machine is connected to recharge the lamp, and from a third similar stud a small strap of metal switches on the lamp. A nut screws on +, and can be so shaped that it can only be removed by a special key, thus (if necessary) forming a lock as in the old safety lamp. The lamp shewn on the table has nothing of the nature of a lock, and it was not considered necessary, as the miner cannot by any possible means get at the light, or obtain a light to any combustible material. Should he succeed in taking out the bulb, the light immediately goes out; and if he replaces the bulb the lamp immediately relights itself, as this one now does. The lamp is furnished with the usual "S" hook handle in place of the leather handle too often seen in new forms of electric safety lamps. The smaller lamp is said to burn 7 or 8 hours, the larger one 10 hours. The smaller lamp weighs about $3\frac{3}{4}$ lbs., and is reported to give 15 per cent. more light than an ordinary safety lamp. The larger lamp is double the size of the smaller one; it contains double the number of cells, and gives double the light, and is of course heavier in weight.

This lamp obtained a silver medal at the recent Falmouth Exhibition of the Royal Cornwall Polytechnic Society. It is made by Messrs. Cathcart and Peto, of London, from designs furnished by the writer, and is of very recent manufacture. So early has it been brought before this Institution that the price is not yet decided upon, but the makers hope to be able to produce it at a price within the reach of colliery proprietors and engineers.

Members will have an opportunity of seeing the lamp in the process of being refilled or recharged by a dynamo machine. It takes 4 or 5 hours to refill the smaller one, and about 6 or 8 hours to fill the larger one. This is done of course during the night, when the lamps are not required in the mines. It is possible to refill the lamps in a shorter time, but the slower charging is to be preferred.

If desired, a lamp can be supplied (in addition to the one at the bottom), which can be readily fixed on + and − for examining the roof, or for any other purpose. The lamp is lighted immediately on being placed in position, and is extinguished upon being removed.

DISCUSSION.

Mr. T. A. SOUTHERN: Has the durability of the lamp been tested?

Mr. SMITH: The batteries have been in use over two years. The lamp in its present form is quite new. If the lamp is to burn for eight hours, it requires six hours for charging. We have no actual record showing the required horse-power, but I should say that with a dynamo giving 50 volts, if 6, 8, or 10 lamps are placed in series, then about ten such batches, *i.e.*, 60 to 100 lamps, would require one horse-power. There has not been opportunity to test these things owing to an accident at the manufactory. Of course, the number of lamps per horse-power depends on their size. The cells contain liquid, and are fitted with a screw top with a very small hole in it, so as to allow the gas to escape, but if turned on one side it will not allow the liquid to flow out.

Mr. W. B. SCOTT (H.M. Inspector of Mines, Birmingham): Is the battery liable to give trouble by short-circuiting?

Mr. SMITH: The inventor hopes by making each cell independent of the others to avoid short-circuiting. In answer to another question, he (Mr. Smith) said the maker informed him that one of the lamps had fallen off a shelf two or three feet from the ground, and had been uninjured.

Mr. H. LEWIS: Does it take six or eight hours to recharge? That would be great inconvenience.

Mr. SMITH: It is better to charge the lamps slowly when they are off duty. A quicker charge could be given, but the slow one is preferable.

Mr. WILLIAM SPENCER (Leicester): I would like to ask whether at the end of eight hours you have to recharge? My experience is, with another lamp, that it wanes considerably before the end of eight hours.

Mr. SMITH: When the accumulators in the lamp get down the light gradually becomes weaker, and the lamp goes out. At the end of eight hours the light would begin to get dull; it might burn for nine or ten hours, but the light would be continually becoming duller. It is unwise to use the lamp after it has run its full time.

Mr. H. LEWIS: Have you burnt the lamp eight hours yourself?

Mr. SMITH: No, I have not. It has only been finished a short time, and I have not had the opportunity.

Mr. SOUTHERN: What is the candle-power?

Mr. SMITH: The larger is called three, and the smaller two candle-power.

Mr. GEORGE LEWIS said he thought the invention was a step in the right direction. He hoped, before long, they would have an electric lamp which would really be found of some practical use in mines. Up to the present he had seen nothing at all approaching what they wanted; but he must say the lamp before them appeared to be a very useful one, and he hoped efforts would be made by those having a knowledge of electricity to produce a lamp suitable to mining requirements.

Mr. M. WALTON BROWN said there was another point. If there was any gas in the mine the present lamp would not show it. It ought to be made to do so.

Mr. SMITH said they had thought of introducing platinum wire. The lamp was only in its infancy, and it would be for the maker to think these points carefully over. It could also be made to give more light afterwards.

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* A paper read before the Federated Institution of Mining Engineers.

Mr. Southern: You can tilt it? Would the lamp burn upside down.

Mr. Smith: Yes; but the acid might spill. The maker had thought of putting the light at the top; to that, however, mining engineers had objected, as there would be greater liability to damage from falls of roof. Practically the light might be put at the top or at the bottom of the lamp as desired. It was not advisable to tilt it too much on the side because of the small holes. A little of the acid might leak out.

The Chairman: I am sure we are very much obliged to Mr. Smith for bringing the lamp before our notice.

NEW PATENTS—1891

15,953. "Electropathic massage, appliances therefor and for other purposes." J. H. Barry. Dated September 21st.

15,980. "An improved form of carrier for shades and globes for gas and electric light." J. G. S. Cunnington. Dated September 21st.

16,006. "Improvements in electrical insulators." W. H. R. Saunders and W. Griffiths. Dated September 21st.

16,038. "Improvements in telephonic receivers which may also be used as transmitters." A. Marr. Dated September 22nd.

16,076. "Automatic coin-freed telephonic machine." J. Wratitsch and S. Gergacsevics. Dated September 22nd.

16,080. "Improvements in governors for dynamo electric machines." M. S. Conly. Dated September 22nd. (*Complete.*)

16,087. "Improvements relating to electrical traction." J. H. Furman. Dated September 22nd.

16,090. "Improvements in telegraph posts." W. Pitt. Dated September 22nd.

16,091. "Improvements in electric circuits for lighting and other purposes." W. H. Massey. Dated September 22nd.

16,099. "Method of and apparatus for converting the electrical energy of alternating currents into mechanical motion." C. S. Bradley, R. S. Taylor, and R. T. McDonald. Dated September 22nd.

16,110. "Improvements in or connected with automatic regulating devices and in electrically actuated pointer mechanisms applicable therefore, and for other purposes." W. P. Thompson. (Communicated by the firm of Willing and Violet, Germany.) Dated September 22nd.

16,113. "Improvement in suspenders or hangers for electric lamps, applicable also for other articles." T. H. O'Brien and C. O'Brien. Dated September 22nd.

16,119. "Improvements in electric switches." J. B. Carter. Dated September 22nd.

16,120. "Improvements in apparatus for transmitting, recording, and reproducing speech or other sounds." R. K. Boyle. Dated September 23rd.

16,130. "An arrangement to regulate the potential of dynamos." F. E. Beeton. Dated September 23rd.

16,181. "Improvements in electric signalling apparatus, chiefly designed for police service." H. E. Walter. Dated September 23rd.

16,205. "A meter for telephonic and other purposes." M. C. Greenhill and J. R. Shearer. Dated September 24th.

16,250. "Improvements in dynamo machines." R. Hammond and C. J. Hall. Dated September 24th.

16,270. "Improvements in or appertaining to accumulators for the storage of electric currents." W. P. Thompson. (Communicated by E. Correns, Germany.) Dated September 24th.

16,293. "Improvements in the method of and in the means for propelling ships and other vessels electrically." W. E. Heys. (Communicated by J. J. Heilmann and F. Drouin, France.) Dated September 25th.

16,300. "Improvements relating to electrical fittings." C. S. Snell and Woodhouse and Rawson United, Limited. Dated September 25th.

16,302. "New means of effecting communication." H. Y. Dickinson. Dated September 25th.

16,312. Improvements in electric crane hoists, &c." D. G. Shephard and N. G. Thompson. Dated September 25th.

ABSTRACTS
OF PUBLISHED SPECIFICATIONS, 1890.

8,325. "Improved method of preventing injuries to submarine cables." J. M. A. Poncia. (Communicated from abroad by H. Kingsford, of Lima.) Dated May 29th. 4d. The inventor places or lays up in the cable, equidistant from one another and from the centre of the core proper, preferably in the fibrous serving between the usual two sets of sheathing wires, an even number of insulated wires, preferably not less than four, in such manner and position that, should chafe occur to the cable, one or more of these alarm wires must be chafed through before the core proper can be injured. 1 claim.

9,061. "Improvements in electric meters." S. Z. de Ferranti and A. Wright. Dated June 11th. 11d. Consists in providing means for diminishing the amount of current passing through the shunt of the meter so soon as sufficient of the main current is passing through the meter to ensure its motion not being stopped by any friction of the mechanism. 10 claims.

9,212. "A method of and apparatus for utilising fixed electromotors for elevating, hauling, and other like applications." J. G. Statter and S. L. Brunton. Dated June 14th. 6d. The method is based upon the employment of a constant current electromotor, fed by a constant current generator, that is to say, such an electromotor and such a generator as are respectively adapted to receive and to generate a constant current, independently of any variations of resistance or of counter electromotive force. Starting is effected by moving the brushes to such a position on the collector that motion of the armature ensues, the direction of such rotation being determined by the direction in which the brushes are moved, and the torque, and hence the velocity depending upon the amount of angular displacement of the brushes. Reversing is effected by moving the brushes from a position on one side of the normal position before mentioned to a position on the other side thereof. 1 claim.

9,246. "An electro-magnetic separator." J. Ronczewski. Dated June 14th. 8d. Chiefly comprises a revolving drum composed of several pairs of electro-magnets, the coils of which are connected with a commutator mounted on the axle of the closed drum, and adapted to put the electro-magnets automatically in and out of circuit; also a hopper or feeder placed above the drum, and a pair of inclined planes placed under the same, and on which drops the material treated by the separator.

11,041. "Improvements in armoured electric conductors and in jointings for such conductors" J. D. Finney Andrews. Dated July 15th. 8d. Claims:—1. An armoured electrical conductor, having its armour coated with metal by drawing the conductor through a bath of molten metal or by electrolytic deposit, substantially as described. 2. In jointing lengths of armoured conductors together, or to branch conductors, covering the parts exposed for the joint with insulatng material, and preferably with a copper tube, within and around which molten fusible metal is cast, substantially as described.

10,736. "Improvements in electric light fittings for medical and surgical purposes." M. P. Oudin and H. O. Kratz-Boussac. Dated July 10th. 8d. The apparatus forming the subject of this invention is mainly intended to supply physicians and surgeons with a convenient source of light for the inspection of the various natural cavities of the human body. 3 claims.

10,805. "Improvements in methods and apparatus for applying the power of electric motors, especially applicable to electric railways." B. J. B. Mills. (A communication from abroad by T. A. Edison, of America.) Dated July 11th. 11d. In one form of the apparatus two similar electric motors are employed, and these are connected with the shaft to be driven by differential gearing, which may be composed of two wheels mounted loosely upon the shaft to be driven, and an intermediate wheel or wheels mounted upon an arm fixed to the shaft and turning therewith. The intermediate wheels have the capacity to rotate upon their own axes as well as to turn around with the shaft. The two electric motors are connected with and turn the two loose wheels of the differential gearing. With a simple form of the gearing, the rotation of the motors and the loose wheels of the gearing, with equal speed in opposite directions, will cause the intermediate wheels to simply rotate upon their axes without exerting any rotary effort upon the shaft. If one motor runs faster than the other, the intermediate wheels will not only rotate upon their own axes, but will turn the shaft with a speed equal to one-half of the difference in the speed of the two motors, and in the direction of the faster motor. Thus the driven shaft can be stopped or run in either direction, and its speed increased or decreased without stopping the motors or changing their directions of rotation. 14 claims.

10,981. "An improved cut-out for arc lamps." J. S. Warburton. Dated July 15th. 8d. In order to effect the absolute automatic cut-out or electrical isolation of an arc lamp while burning in series or in parallel circuit, together with a number of arc or other electric lamps, the inventor applies to such an arc lamp a suitable mechanical arrangement, consisting of a weighted arm or hanging lever, or its equivalent, which is connected electrically with the positive pole or terminal of the lamp, and which is held in suspension by a pin or detent or its equivalent, forming part of the mechanical controlling apparatus of the lamp, in such manner that so long as the arc does not exceed a certain predetermined length, and the mechanical controlling apparatus of the lamp maintains a normal position, the cut-out is not allowed to come into contact with any part of the lamp connected electrically with the negative pole or terminal of the lamp; but as soon as the predetermined length of arc is exceeded, its resistance to the passage of the electric current causes the mechanical controlling apparatus of the lamp to assume an abnormal position, which thereby effects the release of the cut-out, and allows it to fall and make an electrical connection with the negative terminal or some part of the lamp which is connected electrically with the negative pole or terminal of the lamp; and the absolute electrical connection between the cut-out and the contact is further ensured by the action of a locking catch, pawl or spring, or its equivalent, thereby cutting out or short circuiting the lamp and allowing the electric current to pass through the lamp (or past the lamp as may be arranged) without the intervention of an arc and maintaining the circuit unbroken. 1 claim.

11,042. "Improvements in electric thermometers and thermographs." J. W. Gooch, C. A. Baker, and W. White. Dated July 15th. 8d. Claims:—1. The described method of indicating variations of temperature by connecting the ends of a stretched wire to a source of electricity through coils of two metals having their electrical resistance differently affected by temperature, and sliding a contact along that wire until a galvanometer which is also connected to its ends indicates equality of resistance in both circuits. 2. The construction of thermographs wherein the sliding of the contact along the wire above referred to is effected by clockwork, and has its direction determined by the one or the other of two electro-magnets brought into circuit by the galvanometer, the movement of the contact being traced on a revolving drum, substantially as described.

11,052. "Improvements in telegraph receivers." C. Langdon-Davies. Dated July 15th. 11d. Has for its object improvements in telegraph receivers for vibratory electric impulses, and relates to instruments such as are described in the specification of patent No. 16,616, in the year 1886, where the vibratory impulses in a line bobbin impart movement to a reed and thereby open a local circuit which is normally closed; the action being aided or reinforced by coils in the local circuit which also influence the reed. 4 claims.

11,720. "Improvements in connection with electrical fuses." R. J. Jones and Messrs. Woodhouse and Rawson United, Limited. Dated July 26th. 6d. Claims:—1. In electrical fuses the employment of wire of high conductivity and small sectional area produced by electro-deposition, a burnisher or its equivalent being used during the process of deposition. 2. The combination of the aforesaid quality of wire with the forms of fuse as shown in the drawings, substantially described and for the purposes set forth.

12,013. "Improved compound for electric insulating purposes." W. Sinclair and B. S. J. Mackay. Dated July 31st. 4d. According to this invention, the inventors employ sulphur, pipe-clay, slate dust, and an oxide or oxides of metal in, say, the following proportions:—7 lbs. sulphur, 1½ lbs. clean pipe-clay, 1½ lbs. slate dust, 2 ounces paraffin wax, and the necessary quantity of oxide of any metal, say, of copper or of iron, to suit the desired colour. 1 claim.

12,244. "Improvements in or connected with sockets or holders for incandescent electric lamps." A. V. Newton. (Communicated from abroad by A. Swan, of America. Dated August 5th. 8d. The socket may be described as a tubular metal bracket, fitted with a non-conducting core, through the centre of which passes a metallic tube in metallic contact with one of the line wires, and with one of the wires of the lamp. Standing up from the tubular bracket, or it may be from the insulated core, are two standards, which are embraced at their upper ends by a nozzle, that serves to connect them with the enclosing tube of the line wires. There are also attached to the core two contact pieces, which are connected together by a curved switch. These contact pieces are in metallic contact, the one with a line wire, and the other directly or indirectly with an electric conductor of the lamp. 18 claims.

12,504. "Improvements in holders for incandescent electric lamps." E. P. Allam. Dated August 9th. 6d. The inventor employs a collar piece to which a cylindrical base is screwed, of slate, china, or other non-conductor of electricity. The said base is drilled with two holes on one diameter. Into these holes the contact pieces can be slid. 4 claims.

12,763. "Improvements in or relating to electrical batteries." E. Buffet. Dated August 14th. 4d. The inventor employs pure water as the exciting liquid, while the depolarising liquid consists of a solution of nitrate of soda with the addition of an amount of sulphuric acid just sufficient to convert the nitrate into sulphate, and consequently to allow only such a quantity of nitric acid to pass into the exciting liquid, as is necessary for the combustion of the hydrogen without sulphuric acid. 1 claim.

THE ACTION OF METALS, SALTS, ACIDS, &c., ON INDIA-RUBBER.

One of the best contributions to our knowledge of the action of various substances on India-rubber is to be found in a paper by Mr. W. Thomson, F.R.S.E., in the proceedings of the Manchester section of the Society of Chemical Industry for 1885. Since that date this subject has been placed under further study by Mr. Thomson in conjunction with Mr. F. Lewis, and in a recent paper read before the Manchester Literary and Philosophical Society the results of this investigation are summarised.

The method of examination was very simple. A fine sheet of India-rubber spread on paper was vulcanised by the cold process with a mixture of chloride of sulphur and carbon bi-sulphide, and then the action of various substances upon this rubber was examined, the sheet being separated from the paper, so that the stretching properties could be tested.

The action of various metals was tested by using them in the form of filings which were sprinkled upon the rubber. The whole was then kept at a temperature of 60° Centigrade for ten days. Copper was found to have by far the most injurious action; platinum, palladium, and aluminium have only a very slight action, whilst such metals as cobalt, tin, magnesium, bismuth, cadmium, silver, chromium, nickel, arsenic, iron, antimony, gold and zinc have none at all.

In examining into the action of the metallic salts and oxides, saturated solutions were made in water and painted upon small pieces of the rubber, or, in the case of insoluble substances, pastes were made with water and painted on, the whole being then allowed to dry. The heating was subsequently carried out as before.

The following compounds entirely destroyed the rubber, namely, copper sulphate, copper chloride, copper nitrate, copper ferrocyanide, copper oxide, copper sulphide, silver nitrate, arsenic iodide, strontium chlorate, vanadium chloride, manganese oxide, bismuth chloride.

The following had an injurious effect, viz., ferrous nitrate, sodium nitrate, uranium nitrate, ammonium vanadate.

The following had very little action, viz., lead chromate, ferrous sulphate, zinc acetate, zinc chloride, tin perchloride; whilst the behaviour of about sixty salts having no action at all was examined.

Exceedingly small quantities of copper salts are injurious in rubber and tend to cause it to blacken and gradually decay. With regard to the action of acids, very dilute solutions of hydrochloric, sulphuric, chromic, citric, or tartaric are stated not to be prejudicial; but nitric acid rapidly attacks rubber. A solution of 10 per cent. of sulphuric acid completely destroys the properties of the rubber.

Several of the oxidising agents were found to be injurious, but chromic acid has only a slight action, and acid or alkaline solutions of hydrogen peroxide are practically without any effect.

CORRESPONDENCE.

The Telephone.

Your able article on the above interesting subject, in your issue for last week, fulfils a useful purpose.

Perhaps, however, you have scarcely given sufficient weight to the very definite statement of Mr. Wallace that no system will be adopted until it has been thoroughly gone into and thrashed out in all its details by competent experts.

You may rest assured that it is the intention of those connected with the new enterprise, that the scheme finally adopted shall be the very best that experience and mature consideration can devise.

A. A. Campbell Swinton.

September 30*th*, 1891.

The Telephoning of Great Cities.

I was thoroughly disappointed on reading Mr. Bennett's letter in your issue of the 2nd inst., replying to your criticisms on his B.A. paper, and referring to my letter of the same issue without offering some explanation, simply, I presume, because he cannot dispute the defects of his proposed system so clearly pointed out therein. Mr. Bennett's letter, taken as a whole puts me in mind of a clever boy who has desired something done and because he gets a little hurt in consequence flies into a rage. Mr. Bennett must remember that he as yet is not *our only* telephonist, there are in this country those who have as much experience in this matter as himself, who joined the telephone companies soon after the system was introduced into England, and whom had had previously a long and varied electrical experience.

Such information as he supplies may be suitable for a daily paper, but is far from being instructive in an electro-telephonic sense. Anyone acquainted with the subject under discussion may be apt to draw a similiarity between smokeless powder and Mr. Bennett's telephone scheme, with the conclusion that the former was smokeless but had good effect, the latter being all smoke without effect.

Mr. Bennett's statement that *I think* metallic circuits do not behave as such when grouped in considerable numbers, shows that he had not correctly read my letter, or that he wished to evade practical discussion on the working of his more than doubtful scheme, for I thought nothing of the kind nor did I state so, I simply asserted that up to the present no one (to my knowledge) had any experience of metallic circuits on a large scale, which statement I reiterate.

The system I mentioned as having been changed to the "magneto-annunciator system," was identical with the one proposed by him—metallic circuits *alone* excepted—and was known to us as the Law system, whether it was the *real* Law, Mann, or anybody else's system I do not pretend to say, but I can assure him it was a "call wire system," and I am satisfied that it was worked on similar lines to those he lays down and was found to be inefficient, so Mr. Bennett may add another instance of the "call wire system" being abandoned in favour of the "annunciator," and without such disastrous effects to the poor fellow who had the presumption to consider it the best, without having obtained the approval of *the only telephonist* extant.

The latter portion of Mr. Bennett's letter is simply amazing —*à la* Bennett—and I have every reason to be amazed when I am informed that though the main connection to an exchange is broken, communication is still possible without the necessary repairs being made, especially when annunciators are absolutely discarded on subscribers' private wires, and it will take much more than Mr. Bennett's *simple assurance* to convince me that this is possible; but if this gentleman thinks himself to possess so much superior knowledge to the rest of the electrical engineers—which I for one do not admit—surely he can afford to enlighten them a little on the subject of his miraculous cure for bad telephony, for he cannot surely expect that experienced telephone men will take his bare word, without any proof as regards his being copied in London. I should like to say that in 1883-4 I used the same kind of construction in India and always believed it to be the *American style*.

Mr. Bennett appears to lay claim to everything connected with telephones. When he consents to argue electrically the matter under discussion, I am prepared to meet him, leaving the commercial part of the business to commercial men, believing, as I do, that no man can occupy both positions with any degree of satisfaction to himself or benefit to his employers.

H. Goodwin.

September 5th, 1891.

I have read your leader of October 2nd with attention if not with profit. To answer it in detail and refute all the fallacies it contains would require a longer paper than the poor little one which has evolved all this heat, and such a paper I have neither leisure not inclination to prepare. It seems I was right in deducing that the criticism was not that of a practical expert, and that the writer did not come up to the standard he expressly declared to be necessary. This you acknowledge, and the fact should be borne in mind by any reader really interested in the subject of practical telephony.

On September 11th you termed my paper "ill-considered," and lamented the lack of foresight evinced in planning my scheme; on October 2nd you reproach me with such an unusual amount of foresight as to be actually prepared beforehand to show that all criticism of it would be in vain. This is scarcely consistent.

Then, as to the "palpable mistake":—

ELECTRICAL REVIEW, September 11th.	ELECTRICAL REVIEW, October 2nd.
"When Mr. Bennett gets beyond his great city, and refers to Continental connections, he appears to overlook that instead of intercommunication with Continental subscribers being a consequence of the adoption of his system, it would be difficult to have that communication unless similar *plans of service* were adopted in, say, Paris and Brussels; supposing that Paris, in common with others (*sic*), have (*sic*) adopted the signal system, it would be necessary for Mr. Bennett to succeed in convincing them (*sic*) that the circuit system is the only one possible, and inducing them (*sic*) to make the change. In the event of failure so to do, *the London system would be isolated.*"	"We did not make the "palpable mistake" of saying that Continental exchanges would have to be reconstructed in order that London subscribers might communicate with them. We intimated that instead of being facilitated, it would be rendered difficult unless the systems were identical."

If, as is said, no chain is stronger than its weakest link, this contradiction should alone be sufficient to damn your criticism.

ELECTRICAL REVIEW, Sept. 11th.	ELECTRICAL REVIEW, Oct. 2nd.
"Whilst the central is in one respect simplified, it (*sic*) is set off by the circuit wires and additional apparatus at the subscribers."	"The expense of the central office apparatus dispensed with and the subscribers' apparatus added we did not specifically refer to."

There seems room for some adjustment here too.

ELECTRICAL REVIEW, Sept. 11th.	ELECTRICAL REVIEW, Oct. 2nd.
"Both in the paper and in the discussion there seemed an absence of knowledge on his part of later developments."	"We gather from the sources of information to which Mr. Bennett refers, that *if there are any recent developments* they have not, as he says, worked many miracles. We would like to see something of, and hear some things better by, them. But Mr. Bennett must *not jump to the conclusion that they exist* on the strength of our reference to later developments."

I am not quite sure that I understand this, but it seems plain that there is haziness about later developments on the part of somebody besides myself. I, *too*, would like to learn something of such developments, and I, therefore, repeat my invitation to your contributor to favour your readers with an early account of any he may know of. In the meantime I do *not* jump.

I decline to split straws about the Law and the Mann systems; as I said before, the questions (which were introduced by your critic himself) about identity and priority are quite immaterial. I care not one jot about them. Your readers must judge whether you have or have not succeeded in annihilating my proposals by worrying your own bogle. I still maintain that my comparison of movements is accurate. Instead of vague allusions to decimals, in which I, for one, cannot detect any meaning, why does your critic not show how to make a better one? I invited him to do so last week, and now repeat my invitation. But what does a movement more or less signify? Any system must be judged by its broad results. You may say that mine has not been tried. Well, granted; at least that fact should preserve it from condemnation in the meanwhile. But your critic's system—annunciators, multiple switchboards, concentration of wires—*has*. The London subscribers are now enjoying its results. I would ask your readers to keep this little fact well in view.

If your critic's ideal system is *not* the London one, then let him accept my last week's challenge, and expound it in your columns.

In conclusion I must express my sincere regret and very great surprise that what is, at all events, an earnest attempt to suggest a remedy for a state of things which is notorious to all the world, should have met with such a thoroughly hostile reception at the hands of a journal like the ELECTRICAL REVIEW. Your articles, whatever the intent may be, will tend to justify and prolong the present state of things telephonic in London. You condemn everything in my proposal that deviates in the slightest degree from the existing London switchroom practice, and so far from feeling offended at your articles (my allusion last week to unkindness was ironical) I ought to, and, in fact, do, feel highly gratified and flattered. Your critic is no doubt an able exponent of the Morgan cult, but it is a cult with which I have no sympathy, a fact which will prevent my agreeing with him on many subjects; even in the commonplace matter of grammar we run evidently on diverging lines.

A. R. Bennett.

October 6th, 1891.

[We are sorry that Mr. Bennett has no better answer to our criticisms than the attempt to prove our inconsistency by parallel quotations apart from the context. No other "adjustment" is necessary in the first and second parallels than a correct reading of our words with the context. The third parallel is, we regret to say, "disingenuous and calculated to deceive," since it omits the necessary information that the "developments" referred to in our criticism were not the developments Mr. Bennett supposed them to be. We had to express our ignorance not of developments which we know to exist, but of developments which Mr. Bennett supposed to be referred to. We are quite sure that anyone reading the whole of the paragraph from which Mr. Bennett makes a partial extract will see that no explanation is needed. It is curious that Mr. Bennett should take so much trouble to split verbal straws and decline to avail himself of an opportunity of putting himself right on far more important matters. Until he does so we can see no good in the continuance of a correspondence which has all the objectionable features of controversy and none of the advantages of discussion. We cannot follow Mr. Bennett's example in assertive self-praise. We will leave our articles and Mr. Bennett's letters to speak for themselves as regards the respective knowledge shown of the subject as well as the comparative fairness and accuracy of its treatment. Every point referred to by Mr. Bennett is simply a quibble.—EDS. ELEC. REV.]

Railway Train Lighting by Electricity.

The question of railway train lighting by "electricity" is one of such great importance to the general public, if only from a hygienic point of view it is to be hoped that this subject will be fully discussed in your columns, and the matter thoroughly threshed out by railway men, as by this means it may tend to bring about the objects we all have in view, viz., "*a better and healthier illumination in our railway trains.*"

As regards the Timmis system, there are apparently some good points which are worthy of consideration, but taking the paper and his ideas as they stand, they appear somewhat complicated, and leave considerable room for improvements and adverse comment being made thereon.

Mr. Timmis says every carriage must carry its own light, "quite so;" Mr. Timmis also states that the batteries must be light in weigh, "quite so." But why use batteries of 100 cwt. when a few sets of the Woodward multipolar type 8-volt batteries weighing 40 to 60 lbs. will suffice?

Mr. Timmis recommends a 50-volt 8 C.P. lamp as his standard of light. But I ask why use a 50-volt carbon filament lamp which requires at least 26 or 27 cells to light them, whereas if a 20 or 30-volt low resistance semi-metallic carbon coated filament or duplex lamp is used it only requires, say, 11 or 16 cells to brilliantly light them. This reduction of weight alone, which does not appear much on the face of it, but when one comes to calculate the extra weight for, say, 30 or 40 carriages fitted with separate batteries the coal bill will be found to be a large item to figure upon.

Besides, carbon filament lamps are not at all suitable for train lighting, they are too fragile for hard wear, hence so many breakages by using lamps of the carbon filament class. I have always, as is well known, been a staunch believer in low resistance lamps, more especially for portable battery lighting, and I again repeat this fact, and would also state the lower the better for storage battery lighting, and until some practical expert can prove to me by solid facts, and also by time tests, that a 50-volt high resistance lamp, taking, as a rule, over 1 ampère of current (therefore 26 cells where storage is used to light them), is more economical than a 20-volt low resistance lamp as above described, taking, say, 2 ampères, or even 2½ ampères, if long life is insisted upon; and although this class of lamp apparently consumes more current (all things being equal), it is far the best lamp to adopt, for reasons hereafter explained, and until proved to the contrary, I shall stick to my text, and still go on believing in the superiority of a 20 or 30-volt low resistance lamp over that of 50 or 60 as now used for train lighting, for the following reasons, viz.:—

1. It takes fewer batteries to light the low resistance lamps, hence it takes less outlay of capital for battery plant to obtain the same results.
2. Much less weight to carry on the trains, hence a reduction in the cost of maintenance and charges upon rolling stock.
3. Much easier to handle when removals are necessary, hence reduced cost of labour, wages, &c.

Besides, small well made batteries of the modern multipolar types can now be obtained, which can be rapidly charged for a space of, say, two hours, to last for either six to eight hours' discharge, in case of need, without damage to plates, hence their economy for train lighting, and last, but not least, a low resistance lamp has a much longer life than a higher one by reason of its stout, short, thick filament which prevents rupture by vibration, therefore this fact alone, at the present price of lamps, is one well worthy of the careful and special consideration of the consumer.

Mr. Timmis quotes a 50-volt 8 C.P. lamp as taking ·6 of an ampère. This lamp is certainly a marvellous one "*if his measurements are correct.*" I have made some thousands of 50-volt 10 C.P. lamps in days gone bye, but could never produce a reliable lamp for constant work taking less than ·860 or ·9 of an ampère, and at present I know of no lampmaker even in the present improved state of the art who can make such a lamp as described by Mr. Timmis, and if true it is just the lamp we want and have long been looking for, and if it is to be got perhaps Mr. Timmis would kindly say where such lamps are obtainable, for I am sure there are many besides myself (pending the present lamp monopoly) who would be very glad to give good orders for *such* lamps for use on the continent and for maritime purposes over which, fortunately for consumers, the British Patent Laws do not apply, consequently this field is open to all who can secure the business.

Mr. Timmis in his paper proposes three methods for train lighting to work in combination with his auxiliary system. "*First,*" a dynamo to be driven from the axle. This method for many reasons must be very unsatisfactory, except, perhaps, where the dynamos are built upon the Waterhouse three-brush plan, so that the machine works automatically and adapts itself to all requirements under variations of load or speed, then under such conditions for charging the master sets of cells, placed in the guard's van, who, by-the-bye, in his spare time between stations could easily attend to the machinery, in which case such a combination may be profitably utilised.

Mr. Timmis next proposes a dynamo and engine on the locomotive. This plan is very cumbersome and expensive to work, requires considerable outlay for special plant, besides the cost of a separate engineer to attend to the lighting plant, if accidents are to be prevented or avoided.

Lastly, Mr. Timmis proposes charging the batteries from central stations on the route. This plan, I think, has the most objections of all, unless water-power is available to generate cheaply, for this method would require heavy outlay for plant and buildings, besides a special staff of electricians. Heavy wear and tear by removals, rough usage by railway porters, long delays and time lost in changing plant, frequent and complele examination of circuits, and a host of minor things, all adding to expense, thus making this last method, to my mind, quite impractical except for block train service systems, such as are used for underground work, where the charging of "*a specially constructed electric storage van*" could be replenished during the night and ready for the following day's consumption.

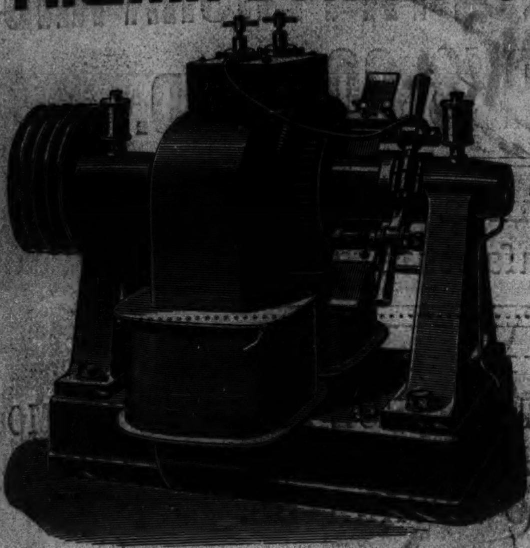
I am clearly of opinion that if the present locomotive boilers were converted into "thermo-electric engines," which could be easily and cheaply done by covering the boilers over with a properly-constructed "thermo element," that the waste heat now lost could by this plan be profitably utilised for generating "thermopolaic currents" to charge small sets of suitable storage batteries placed under the seats, and used to light the trains.

I am quite aware my suggestions are entirely fundamental, and will require putting into actual practice, and also that the voltage obtained from "thermo elements" is low; but from experiments made, I find the ampère output *large*, therefore it only remains to subdivide the elements according to requirements; therefore I see no reason why this plan of generating current cannot be adopted and utilised for the above named purposes, at the same time in order to make a success of the above. It is simply a question of £ s. d., and therefore the important question which engineers have to consider is simply to find out, by actual time tests, "the best, most economical, and reliable methods for carrying out the objects in view, and by so doing, it will enable engineers to develop a very important section of the electrical industry.

Arthur Shippey.

[This letter of Mr. Shippey's is in substitution of one previously sent to us, and it was upon the first that the remarks on another page were made.—EDS. ELEC. REV.]

PHŒNIX DYNAMOS



PATERSON & COOPER,
POWNALL ROAD, DALSTON,
LONDON, N.E.,
Makers of
ELECTRIC LIGHT & TELEPHONE APPARATUS
OF EVERY DESCRIPTION.
◆◆◆◆◆◆◆◆◆
WRITE FOR PRICE LISTS.

PHŒNIX DIRECT CURRENT DYNAMOS.
"S" TYPE. MODERATE SPEED.

Size.	OUTPUT IN WATTS.	Difference of Potentials in Volts.	No. of 60 Watt Lamps.	Approx. Speed.	Approx. Horse Power.	PRICE.	Extra for Bedding Rails and Tightening Screws.	Extra for Fly Wheel for Gas Engine.
						£	£ s.	£ s.
1S	600	30 to 60	10	1,800	1	20	1 10	2 0
2S	900	40 to 70	15	1,750	1½	24	2 0	2 10
3S	1,200	50 to 80	20	1,700	2	28	2 10	3 0
4S	2,100	50 to 110	35	1,600	3½	33	3 0	3 10
5S	3,000	60 to 110	50	1,520	5	44	3 5	4 0
6S	4,500	60 to 110	75	1,480	7½	55	3 15	4 10
7S	6,000	60 to 120	100	1,360	10	65	4 5	5 0
8S	9,000	60 to 120	150	1,260	15	85	5 0	5 10
9S	12,000	60 to 120	200	1,180	20	105	6 0	6 0
10S	18,000	80 to 150	300	1,020	30	146	8 0	—
11S	24,000	80 to 180	400	900	40	186	10 0	—
12S	30,000	100 to 200	500	800	50	225	12 0	—

These prices refer to Compound, Series or Shunt Machines wound to a difference of potentials between the limits given. For those of higher or lower potentials, an additional charge will be made and special quotations submitted.

SERIES DYNAMOS for ARC LIGHTING wound for 10, 15, or 20 Amperes, of Potentials above those given, up to 1,000 Volts.

For the same output, price 10 per cent. over above prices.

PHŒNIX DIRECT CURRENT DYNAMOS.
"D" TYPE. SLOW SPEED.

Size.	OUTPUT IN WATTS.	Difference of Potentials in Volts.	No. of 60 Watt Lamps.	Approx. Speed.	Approx. Horse Power.	PRICE.	Extra for Bedding Rails.
						£	£ s.
6D	9,000	65 to 110	150	750	15	110	6 0
7D	12,000	65 to 110	200	700	20	130	7 0
8D	18,000	65 to 110	300	650	30	170	8 0
9D	24,000	65 to 110	400	600	40	220	10 0
10D	36,000	110 to 125	600	500	60	290	12 0
11D	48,000	110 to 125	800	450	80	375	14 0
12D	60,000	110 to 125	1,000	400	100	450	16 0

Telephone No. 5422. ESTABLISHED 1870. Telegrams: "Flexible, London."

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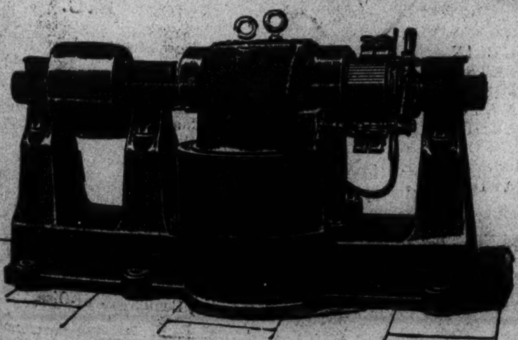

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Specially Wound Dynamos to charge cells and supply constant E.M.F. to Lamp Mains independently and at the same time.
LIBERAL DISCOUNTS TO THE TRADE. AGENTS WANTED.

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